Editorial

LAST month I mentioned the scheme proposed by the British Government to commercially sponsor television programs. It plans to set up a £500,000 corporation to bring this about by the end of this year.

The BBC is finding it extremely hard to get together good TV programs on the revenue from licence fees alone. While many of the best programs have been amazingly successful — the Coronation for instance — the standard of day to day material has caused some concern.

The novelty of TV is something that will not last for ever. Every year in this blase age we see the life of any novelty growing shorter and shorter. Only a budget capable of preserving a good working standard can maintain such a huge project on a sound footing.

The BBC, which to date has carried no advertising, apparently feels that sponsored revenue is the only source of adequate new finance.

According to reports, the proposal has been strongly opposed in many quarters, including the House of Lords. The National Television Council says that the proposed corporation could "prehaps prevent indecency, but it couldn't prevent a steady debasement of programs".

To make our Australian faces a little red, if we feel that way, a correspondent in the London Times, the forum of the Empire, quotes the commercial stations in this country as an example of the evils of sponsorship.

"Each State has two national stations and a number of commercial stations," he writes. "Nothing is advertised that is objectionable by any standards of good taste or morals. But the mental level of the listeners catered for is very low — the programs could appeal to any 12-year-old no matter how dull. The effect on the national stations has been disastrous. The ABC has to compete with commercial stations for listeners. Fragments of culture are carried along on a turgid stream of American jazz music which never ceases".

I feel there is something wrong with the reasoning that National stations should inevitably be dull and classical, and commercial stations cheap and debasing. Such statements surely come from those who are prejudiced one way or the other. However difficult to obtain, it seems that they mostly emphasise the need for some generally accepted policy which will prevent either of these evils.

Broadcasting isn't a good example of such a policy, but the remedy doesn't lie in making all stations either commercial or National. It lies in the use of common sense and well proportioned thinking to guide not only future television but broadcast programs as well.

John Moyle

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OF RADIO, HOBBIES AND POPULAR SCIENCE

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VOL. 15 No. 10

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C'wealth, NZ, N. Guinea, Fiji—18/- pa
United Kingdom—£1/-/6 pa
B. Empire—£1/3/- pa
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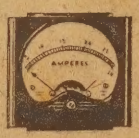

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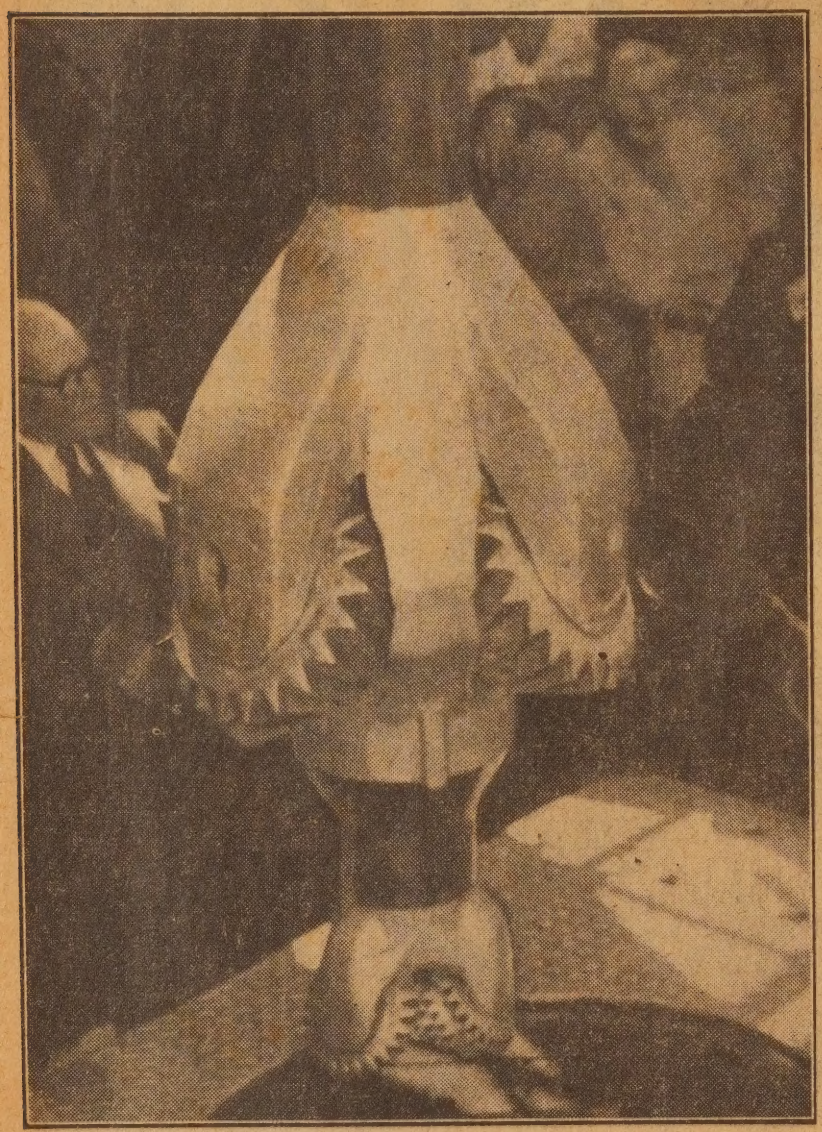
Great lengths of interconnected pipe such as these are lowered into the ground as the drilling experts probe the earth's crust for oil. Just how they fit into the engineer's plan to tap Australia's potential wealth is told in the succeeding pages.

ENGINEERS WHO DRILL FOR OIL

There is probably no more universally discussed subject in Australia to-day than oil. Discussion varies from possible international effects to the actual process of finding oil, while overall there is an air of hopeful anticipation that we might yet strike a "gusher".



The most important "bit" in Australia at the moment. The business end of the drill which cut its way over 3000ft into the earth at Exmouth Gulf to find Australia's first oil deposit. It is planned to drill this well much deeper in the hope that bigger sources will be found.

by Philip Watson

AT the time of writing the find is little more than a trace, having in itself little or no commercial value, but it does indicate that the chances of finding a large deposit are good. More than this, oil men associated with the project will not say.

Nevertheless, to the man in the street, oil—the very life blood of our modern civilisation — has been found in Australia; and he wants to know how it is done.

Modern oil searchers make use of wide variety of techniques and mechanical aids to assist them in selecting a site for drilling. The contours of the land, the nature of the rocks, and other strata as indicated by exploratory drilling, the results of seismographic surveys and many additional factors are all taken into account before a site is picked.

But the surface men cannot say that oil exists. They can only say that the chances are reasonable. Only the process of drilling will indicate whether there is oil present or whether there is a reasonable chance of it being found in the vicinity. For this reason it is frequently necessary to drill several wells before oil is found—if, indeed, it is found at all.

To the average person the idea of drilling a hole in the earth, anything up to four miles deep, appears as a colossal undertaking and, in fact, it is a colossal undertaking. In spite of the progress made in drilling techniques in recent years it is still a long and costly business. One reason for the high cost is the fact that the hole may yield absolutely nothing and the whole process may have to be repeated several times before oil is found or the project abandoned.

Just how does one set about drilling a hole anything from 2000 to 25,000ft deep?

There are two main methods of drilling; the "cable-tool" method and the "rotary" method. The cable tool system is that which was first used for oil wells and was fairly satisfactory when only moderate depths were involved. The deepest well by this method appears to be one of 5000ft and which took six months to drill.

In this method a heavy steel bit is attached to the end of a cable and raised and lowered at regular intervals to pound a hole through the earth and rock. The pulverised rock is removed by mixing it with water and bailing it out. The first oil well in America, known as "Drake's Folly" (until it came good) was drilled by the cable-tool method, and the rate of progress through rock was about three feet per day. Oil was eventually found at 69½ft on August 27, 1859.

The rotary method is a more recent development and, as well as being quicker, has several other advantages. As an example of the faster working, it is considered that the 5000ft well which took six months to drill by the cable-tool method could be done by modern rotary methods in 12 days. Wells up to 25,000ft have been drilled by this method, though such depths are rare.

In this method the actual cutting is done by a rotating bit which usually consists of four heavy-toothed wheels, set at an angle, and which are designed to crush the

PROBE MILES INTO THE EARTH

rock, &c. as they pass over it. A better idea of the construction can be obtained from the photographs. There are many variations of design, such as the number of cutting wheels, their angle, the formation of the teeth, &c., according to the type of material to be cut; ie, rock, shale, &c.

The bit is mounted on the end of a heavy steel pipe, the whole assembly being rotated so that the bit bores its way into the ground. As the hole deepens additional lengths of pipe are added until eventually the bit may be rotating at the end of a pipe several thousand feet long.

STRAIGHT DRILL

One of the problems of drilling is to keep the hole straight, there being a natural tendency for the bit to veer off at an angle if it is not carefully controlled. One means of minimising this is to concentrate as much weight as possible immediately above the bit, and this is done by making the first three or four lengths of pipe of larger diameter and greater wall thickness than the remainder. This is known as the drill collar.

The whole assembly is known as the drilling string and in order to assemble and control it a considerable amount of surface equipment is required. The most obvious of these is the derrick, or steel tower, which may be as high as 190ft.

The main reason for the great height is to permit quick and easy handling of the drill string when it needs to be removed from the hole.

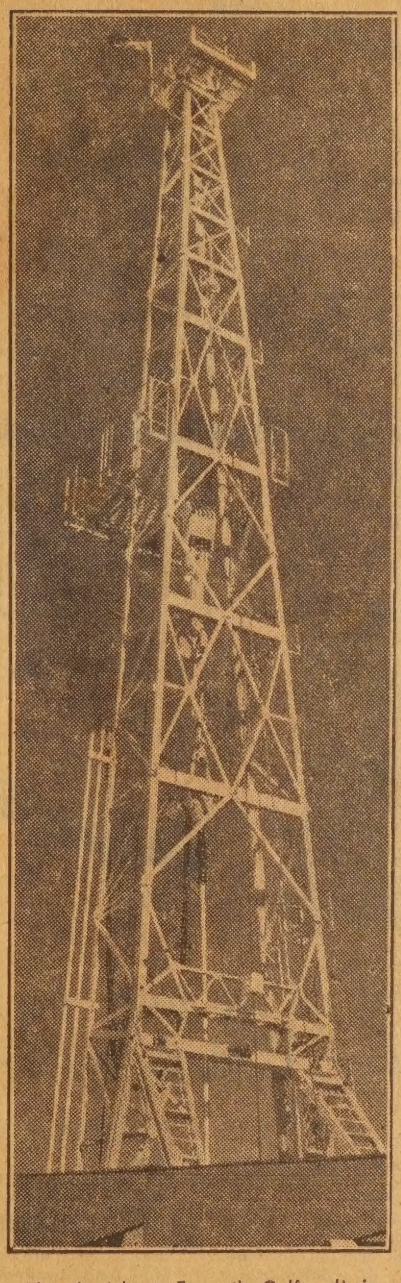
From the head of the derrick is hung a powerful hoist capable of lifting several hundred tons. This is used to withdraw the drill string from the hole, as well as to take its weight during the actual drilling process. This is most necessary when drilling at depth in order to prevent the drilling string from collapsing under its own weight and also to control the weight on the bit.

EXTRA HOISTS

In addition there are auxiliary hoists which are used to handle smaller lengths of drill pipe, casing tube, &c., as well as a power plant to provide power for the entire project. A typical installation might employ as many as four 350 hp diesel engines.

Another very important commodity is mud. Not quite the same kind of mud as used by small boys to make pies, because it is more carefully compounded, but it is, nevertheless, mud. This is pumped down the centre of the drill pipe at high pressure and flows out the bottom, over the bit cutting wheels and returns to the surface in the space between the drill pipe and the wall of the hole.

This mud performs several very important functions. One is to remove the cuttings produced by the bit which are thus brought to the surface by the high rate of flow. It also helps to lubricate the bit and carry away much of the heat generated in the cutting process. This helps to prolong the life of the bit, which is a most important factor due to the difficulty of removing it for replacement.



The derrick at Exmouth Gulf. It is virtually identical to that shown in the drawing. Note the lower block of the hoist about half way up with the kelly and flexible mud line beneath it.

The mud is so compounded that it cakes fairly readily, thus providing a temporary casing for the hole to minimise cave in or the entry of unwanted water or gas. Finally, the fact that the hole is full of mud serves as a very effective method of sealing it in the event of the drill striking oil or gas at pressure.

Modern oil drilling techniques are such that the "gusher"—the spectacular jet which suddenly shoots skyward and drenches the cheering workers in black oily fluid—is regarded as extremely bad practice. For one thing it is extremely dangerous, both because of the direct damage due to the terrific flow and also because of the risk of fire. It is also extremely wasteful, allowing thousands of barrels of oil to flow to waste and much of the precious gas pressure to be lost before it can be capped.

Since it is the gas pressure which forces the oil to the surface it is just as important as the oil and must not be wasted. Thus the mud is a very important part of the control system.

BIT SIZES

To give some idea of the size of the bits and the holes they cut we quote some of the figures from the Exmouth Gulf project. The hole was initially cut at 12in to a depth of 600ft. This was then reamed to 25in and lined with metal casing approximately 20in in diameter. Drilling was then continued at about 15in diameter.

The drill pipe is seamless drawn steel tubing varying from 4½in to 7in diameter and with a wall thickness of the order of half an inch. It is usually used in 30ft lengths.

In short lengths this appears perfectly rigid but when connected into lengths several thousand feet long and called upon to transmit the power from the surface to the bit it becomes extremely flexible. For this reason the weight on the bit must be very carefully controlled in deep drilling if the pipe is not to be twisted and broken.

When this happens a lot of ingenuity is required to extract the bit or, if it cannot be extracted, the well must be abandoned and another one commenced.

IMPORTANT POINTS

For the successful operation of the drill string several important conditions must be fulfilled. These are (1) The weight of the string must be supported by the hoist; (2) While so supported it must be free to rotate; (3) While rotating it must be free to fall slowly as the hole deepens; (4) Also while rotating it must be fed with mud at high pressure. To perform all these functions a device called a "kelly" is used.

The kelly consists of a length of square pipe, somewhat longer than a length of drill pipe, and to the top of which is fixed a special bearing, or swivel, which not only carries the weight of the drill string while it revolves, but also allows the mud to feed into the revolving pipe without appreciable loss. The lower end of the kelly is threaded to fit the drill pipe.

At the foot of the derrick and about 12ft above the ground is a

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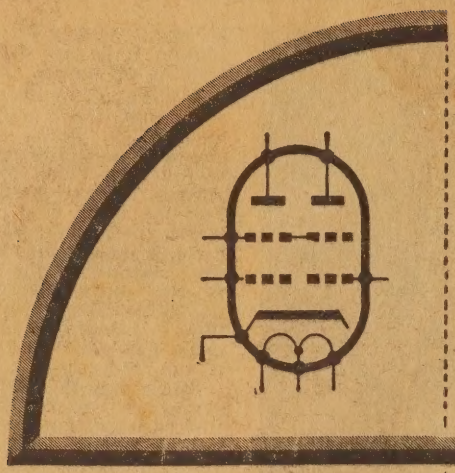

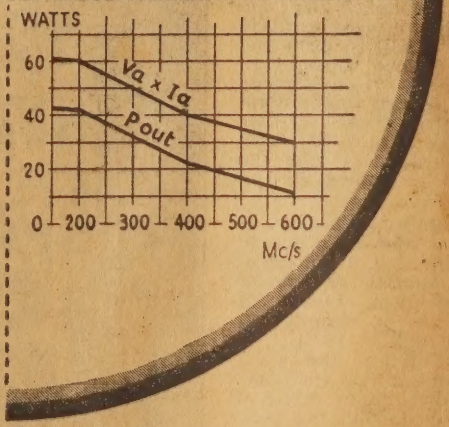

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Brief technical details of the QQV03-20 are given above. More comprehensive information will be gladly supplied on request.

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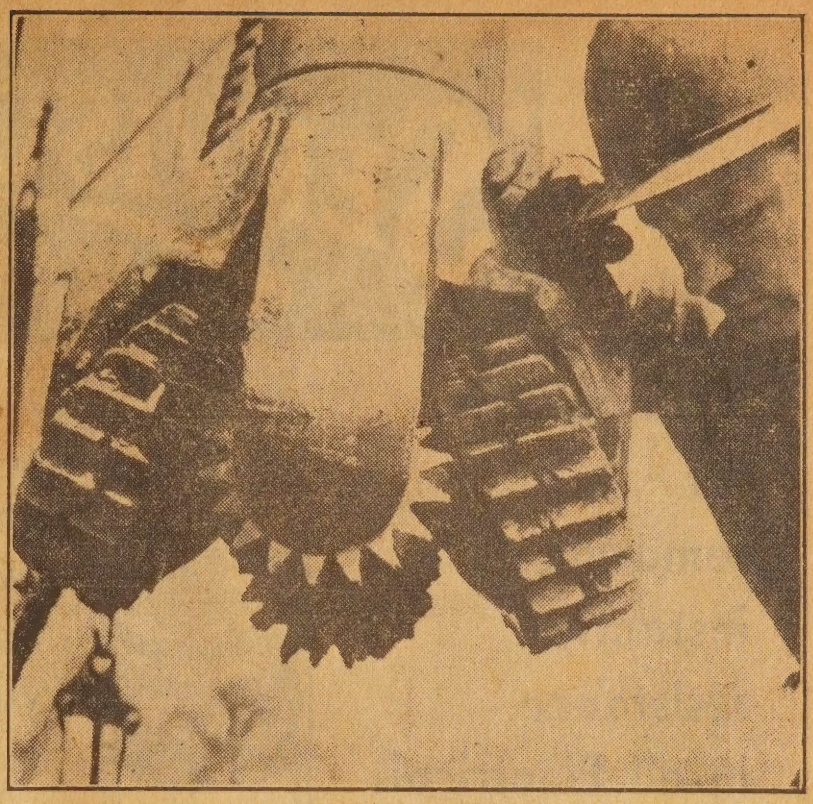
MR7-53

platform called the derrick floor. It is at this level that most of the pipe handling operations are carried out as well as the point at which the rotary motion is imparted to the drill.

A device called a rotary table is used to rotate the drill and this is mounted on the derrick floor. It consists of a subsidiary platform carrying a rotating block mounted on suitable bearings. This is driven from the power plant by means of a reduction gearing and imparts its power to the kelly by means of a square hole in the centre, and through which the kelly passes.

Fastened into the ground at the top of the hole and rising to just below the derrick floor is the conductor pipe. From the side of this runs a mud line to carry the mud from the hole to the mud pit, a metal tank where the mud is filtered before being returned to the drill string. The conductor pipe also carries the blowout control valves, or "preventers", which are high pressure valves designed to control the oil if it should be struck at high pressure.



The type of bit frequently used for cutting through rock. The sharp edges combined with the weight of the bit crush the rock into small fragments which are then removed by the flow of mud.

During the process of drilling there are two operations which must be carried out at regular intervals and which account for much of the time and cost of drilling. These are the adding of lengths of pipe to the drill string as the hole deepens and the removal of the bit when it becomes worn or damaged.

When a new length of pipe is to be added the hoist lifts the entire drill string high enough to bring the joint between the kelly and the first pipe length just above the derrick floor. Special grips are now fitted into the rotary table to support the drill string while the kelly is disconnected and swung clear.

Meanwhile a new length of pipe has been brought from the stack, hauled into an upright position by means of the auxiliary hoist, and stood alongside the drill string in what is called the "mouse hole". The kelly is now swung over this pipe and coupled to it, then hauled farther up the mast to allow the lower end of the new pipe to be coupled to the old one.

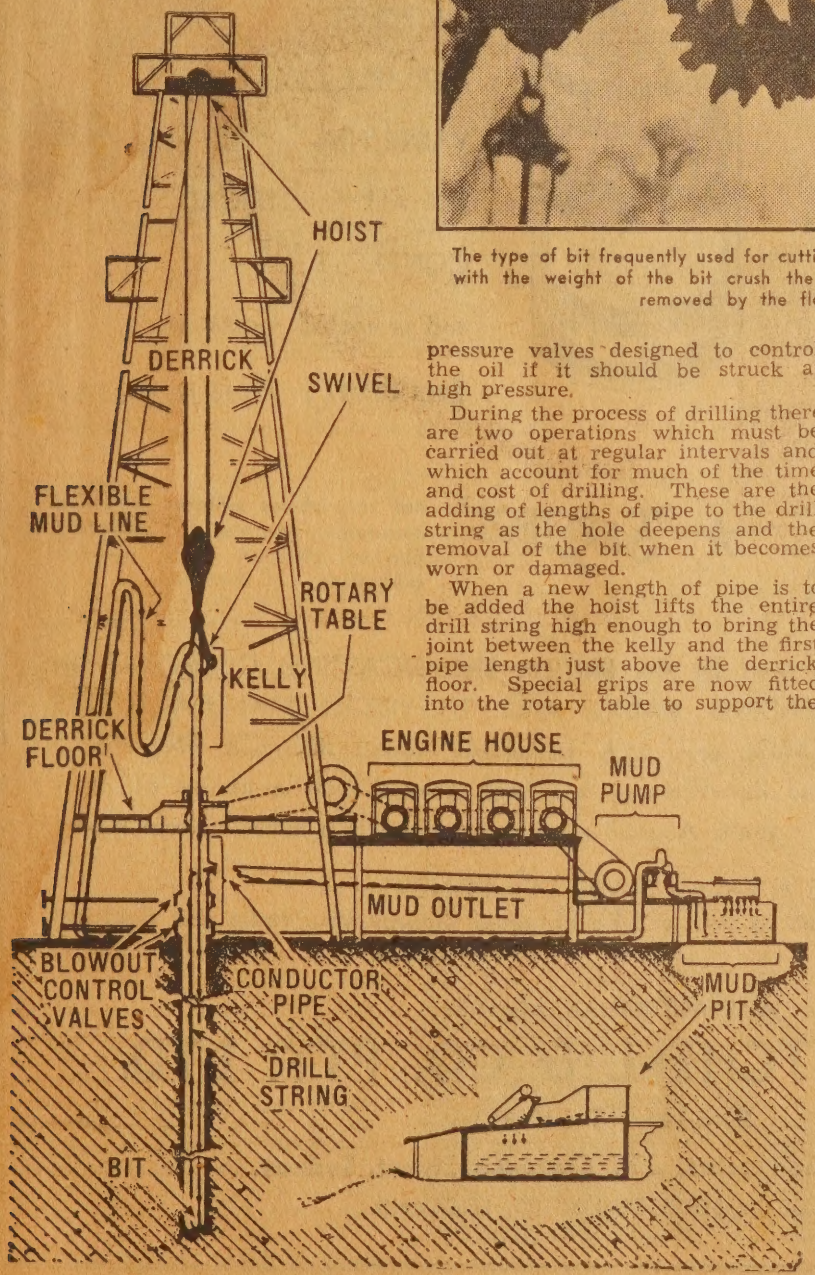
SPEEDING UP

This done, the lengthened string is lowered until the bit touches bottom, the kelly is re-engaged with the rotary table, and drilling recommenced.

To speed up the threading and unthreading of the pipe, use is made of power from the auxiliary hoist. This is done by wrapping a chain around the pipe and attaching the other end to a line from the hoist. By hauling on the line the pipe is rotated as required.

The above procedure has to be repeated for every 30ft of drilling depth, this being the normal length of a section of pipe. Since time required to add a length is time lost in drilling, every effort is made to

(Continued on Page 23)



This diagram gives an excellent idea of the layout of an oil drilling project. Note the mud circulating circuit which is all important to keep the bit lubricated and flush out the cuttings. Rotary motion is imparted to the drill string by the rotary table on the derrick floor.

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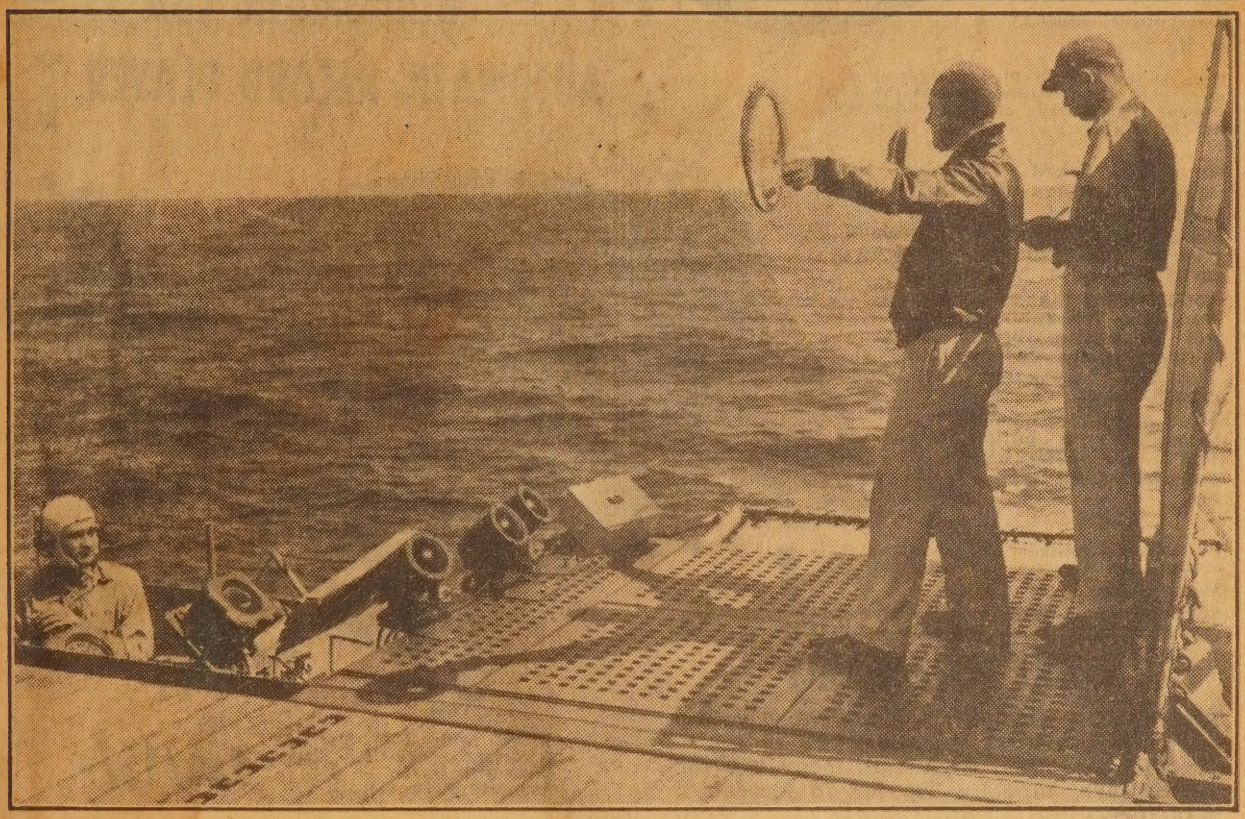


Radar waves are kept trained on the jet plane as it comes in for a landing on the carrier's deck. The "echoes" rebounding off the plane and picked up again by the antenna serve as the basis for the new speed indicator to compute plane's true air speed. This information is relayed by cable to the dial at the feet of the landing signal officer. The LSO guides jets to safer landings.

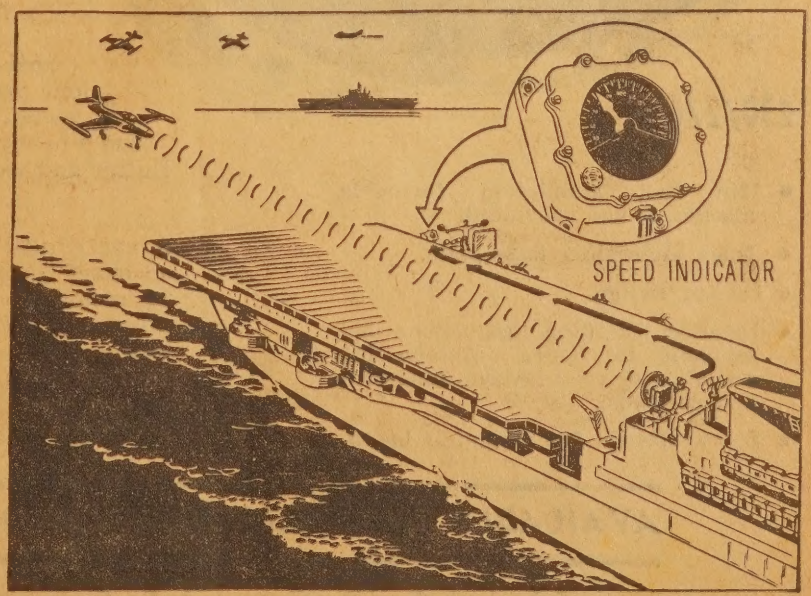
The lives of jet pilots and the complex and costly aircraft they fly are being safeguarded by remarkable new electronics device that "clocks" an approaching plane and indicates whether or not it is coming in at a safe landing speed.

THE new radar speed-measuring equipment developed by Raytheon Manufacturing Company of Waltham, Mass., USA, was made under the joint auspices of the Navy's Bureaus of Aeronautics and Ships, to help fast-flying jets to land safely on aircraft carriers.

Military secrecy was lifted as naval authorities described the new device. Installed on the carrier, it "watches" the approach of a plane coming down for a landing, and warns the landing signal officer if the plane's speed is too fast or too slow. The officer then wig-wags his orders to the pilot, either guiding him down to a landing, or waving him off for another try.

Too fast a speed, of course, would cause a jet to "overshoot" the arresting cables or the entire deck. Too slow a speed is extremely dangerous, for the plane becomes wobbly, and may stall in mid-air, plummeting into the sea or on to the deck with destructive force. With jet aircraft, unlike propeller-driven planes, there is only a narrow spread between too fast a speed and too slow. Pilots find it increasingly difficult to control the speed of modern fighter craft within the limits allowed by carrier operations.

The new speed measuring equipment takes into acount automatically



Landing Signal Officer uses conventional wig-wag flags to guide jet pilot safely down to carrier deck, but is aided by the new-mounted dial of the new speed indicator, a radar device that tells if plane is approaching too fast or too slow.

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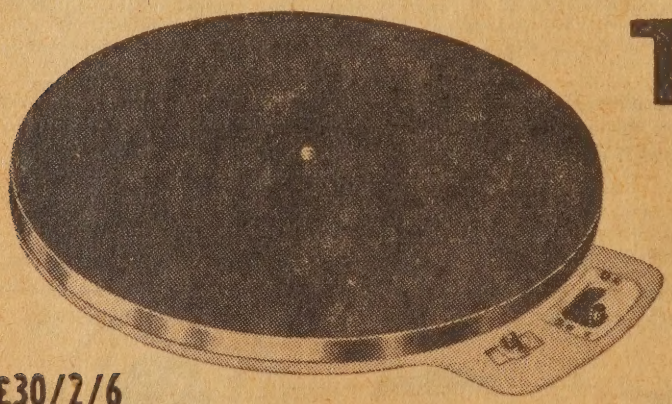

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A ROBOT BRAIN WRITES VERSE

Scientists are continually experimenting with machines which duplicate in some measure the processes of human thought. This interesting article describes the fascinating results of work by a French specialist in the art.

By PIERRE DEVAUX

FRENCH "Cyberneticians" have recently scored a hit with a revolutionary new item: the Electronic Poetess by Albert Ducrocq, which, far from "reasoning" like existing electronic brains, actually performs the most amazingly fantastic artistic improvisations.

Calliope—for such is the mythological name of the new machine—has already composed Byzantine tapestries . . . and a poem in prose which stands somewhere between the hallucinations of Edgar Alan Poe and the terse elegance of Villiers de l'Isle Adam.

PROMPT SERVANT

The electron, that granule of "free" negative electricity which whirls in the void of our radio valves, is a prodigiously prompt servant capable of working out gigantic calculations in a few micro-seconds.

Twenty million multiplications or divisions are quite a reasonable ration for the marvellous "Electronic Brains". Astronomers, physicists and even sociologists are now calling upon their services, and with pride and modesty, the atomic scientists declare that without the famous ENIAC they would never have been able to "calculate" the atomic bomb.

On both sides of the Atlantic we now possess business models of the Electronic Brain of more modest dimensions and cost. These "super office machines", like their gigantic predecessors, are confined to calculations. On an incredible scale and with amazing speed, they perform what was done hitherto by the cog-wheeled machines that one saw at work at shop pay desks, at money changers' and banks.

ARTIFICIAL MEN

The scientists did not wait for electronics before realising that every logical process of the human intelligence can be handed over to a machine provided that the latter be brought up to the required state of perfection. In this sense, the machine or the robot are indeed really "artificial men" and man's rivals. Within limits, they can be made to manage a factory, run an assembly chain or regulate an electricity network. But these machines could never, never come to produce a work of imagination or poetry.

Mr Albert Ducrocq's creation is something quite different. He strove to endow that strange "Sensitive Robot", that artistic automaton, with something comparable to human faculties and, one would think, those most impossible to reduce to an equation.

If they are to rise to the creative faculties, machines need something more than logic—the "eminent and dangerous" element of chance—but a "controlled" form of chance, forming the artist's arbitrary. Introducing chance into the electronic machine and "canalising" it to obtain a coherent result, would thus be the two stages the inventor would have to reach in order to create the new machine.

He does seem to have reached that goal by using "chance cells" and an "interpretative dictionary".

One should picture a "chance cell" as a three-horned ampule forming an "electronic needle". If you send an electric impulse along horn 1, it is absolutely impossible to know whether it will come out by horn No. 2 or horn No. 3. The element of chance is complete.

The chance cell may, of course, somewhat resemble the traditional flip-flop, that curious double electronic valve which is the calculating part of Electronic Brains. But there is a tremendous difference—the flip-flop can only be logical, it reckons and registers like a calculating machine . . . but, it has not a grain of imagination.

If a certain number of chance cells are associated by electric circuits so that the first cell in part determines the working of the next cells, we shall have thus introduced a sort of inner logic of human language, where the beginning of the sentence limits the possibilities of the end.

A NEW electronic robot, invented by French scientist Albert Ducrocq is said to be an advance on previous inventions of this type. This electronic fox, named "Job", has many "sense" organs. Two photo-electric cells in its head give it three-dimensional vision, a microphone connected to an amplifier forms its "ear", while the sense of touch is represented by numerous contact points which react on touching an obstacle. Other contracts, in "Job's" neck, give the electronic fox a sense of direction. Moreover, it possesses a sense unknown to man—a "size gauge" which enables it to estimate the size of an obstacle at a distance, by the reactions induced in its triangular "nose".

"Job's" behavior depends not only on its present sensations, but also on previous experience. The electronic fox is always "learning", thanks to its "memory"—a series of magnetic circuits. Thus its "mentality" is constantly being modified by its store of memories of past experiences — as in the case of most living beings.

Although "Job" cannot speak, it can express itself by means of two lamps—a red one and a green one — that light up on top of its "head".

Photo shows Ducrocq demonstrating his robot, which is wearing its fox-skin.

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5-7L	5	780	115	110-6,000	3.5	7 3/16 x 5 1/2	3 1/8	6 7/16 x 4 15/16
6-9H	4	770	115	110-5,500	3.5	9 7/32 x 6 11/32	3 5/16	8 1/16 x 5 7/16
6-9L	5	770	115	110-5,500	3.5	9 7/32 x 6 11/32	3 1/2	8 1/16 x 5 1/16

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So when Calliope begins with these words, "Rome is . . .", it may add, ". . . one of the most famous of all cities" or ". . . the capital of Italy", but an infinite number of sentence ends will be impossible. Psychologists will say that this is the classic system of "association of ideas".

Calliope is not a copy of a human being like robots or the Automatons of Vaucanson and Roentgen. It looks like a kind of radio set with a red light and a green light for the operator. These two lamps light up every second in an order that cannot be foreseen and determined by the chance cells. By agreement the green light represents 1 and the red light nil. Pencil in hand, the operator obediently notes down the sequence of 1's and nils supplied by Calliope.

INTERPRETATION

It remains for us to interpret the "absolute language" of Calliope, that series of 1's and nils identical with the results supplied by Electronic Brains in "binary notation".

Here we have a specially composed dictionary which is a miracle of logic. For instance 111 means a living creature, one more 1 a man, 1.111, whilst 1.110 means "living creature not man", therefore a plant or an animal.

Being logical like any machine, Calliope hates pleenasm. She will not say "the dog barks", but "the dog noises" . . . for obviously the noise of a dog is a bark. There is a special difficulty here, especially in literary language, where the sense of a word "heralds", to a certain extent, the following word, just as a chord in music demands its resolving. But surely it is precisely this inner necessity which guides the electronic artist and prevents any dropping into incoherence.

ROBOT PROSE

The reader will probably be interested to see a piece of Calliope prose for himself.

"My only horizon is a red curtain from which suffocating heat issues. One can hardly distinguish the mysterious figure of a woman, proud and terrible . . ."

As to Calliope's tapestries, they were obtained by marking in black and white the squares of a checked surface to the "dictation" of Calliope's lamps. Here again, the eye perceives an undoubtedly "imaginative logic", a scattering of Greek crosses combining regularity with fancy.

Such is the curiously "anthropomorphic" creation of French electronics. One wonders how Cyberneticians on both sides of the Atlantic will manage to classify this wayward newcomer in their systematic index systems!

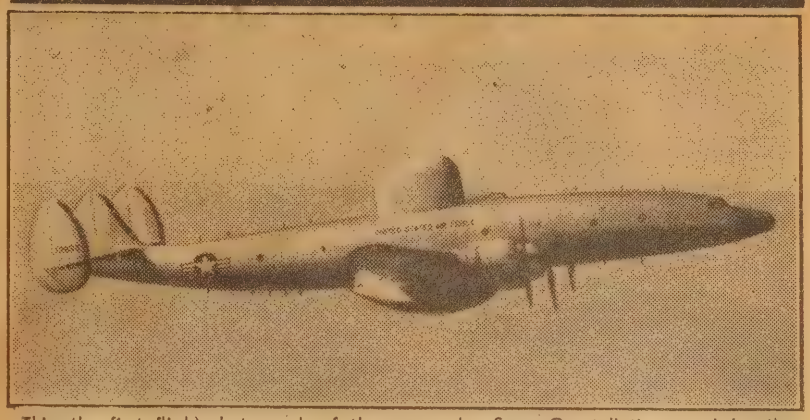
★ ★ ★

FOOD can now be packed into loose-fitting plastic bags which can be shrunk to fit their contents as they are sealed.

The plastic used is a special type of saran with a vinylidene chloride base. When immersed in water at about 200 degrees Fahrenheit the film shrinks 30 pc to form a skin-tight package.

Such dissimilar materials as glass, aluminium, paper, cellophane, vinyl and polyethylene are being used to keep moisture in food packages and to keep out oxygen that would impair food flavor.

RADAR CONSTELLATION FOR USA



This, the first flight-photograph of the new radar Super-Constellation, used by the U.S. Air Force and Navy, shows its distinctive protuberances. The aircraft carries America's most powerful sky-search equipment to high altitudes, and over long distances, and copes with the normal inability of radar to bend over the horizon.

Flying radar stations, new high-altitude reconnaissance aircraft bulging with electronic detection apparatus, are in production for both the US Air Force and Navy. Like magic spyglasses, they are designed to carry powerful search radar to high altitudes where radar beams attain their maximum effectiveness in spotting either surface or air targets. Exact effective range of the radar is not revealed.

THE new defence weapons will be special versions of the Lockheed Super Constellation transport model, powered by turbo-compound engines and capable of long range, long endurance and high altitude.

Army aircraft will be used to give USAF air-defence forces extra-early warning of approaching targets.

The Navy will use them primarily to screen US fleets. They will be able to fly from land bases to points far at sea, where they can partol for long periods.

The radar planes, packing more than six tons of electronic equipment and accessories, will be a wholly new shape in the sky.

Protruding from the top of the fuselage will be a 8-foot-high structure resembling the dorsal fin of a sailfish. It will house a height-finder radar antenna.

Mushrooming from the bottom will be a bowl-shaped radome, described as "probably the largest plastic part ever built."

Powered by four 3250-hp Wright turbo-compound engines, the aircraft will possess all the range and altitude capabilities of commercial Super Constellations. Tiptanks carrying extra fuel will give added range. Despite the huge radomes, speed will approximate the 335 mph cruising speed of airliner versions.

Besides its high-altitude sentry duty, the new electronics plane will be able to track weather disturbances by radar and improve storm warning services.

Facilities for a crew of up to 31 men are provided. Cabins are soundproofed. Seats are scientifically designed to minimize fatigue on long missions. Each plane will carry a complete electronics maintenance shop and a team of specialists to make in-flight adjustments and repairs.

The design provides for a galley for meals aloft and bunks for off-duty crews. Cabins are pressurised to maintain 10,600-foot comfort at 25,000 feet. The interior can be kept at an even 75 degrees despite 60-below-zero temperatures outside.

RADAR HELPS PLANES TO LAND

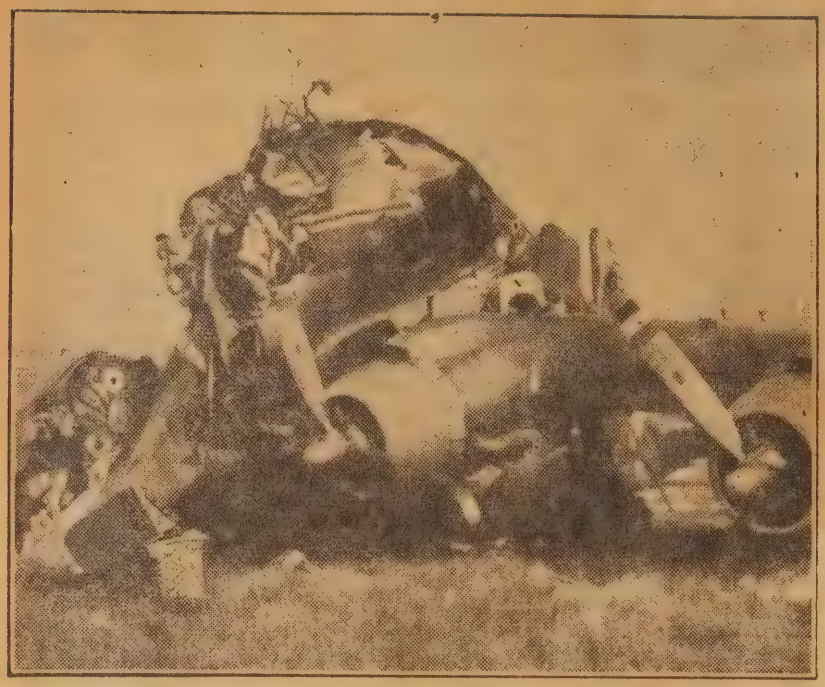
(Continued from Page 9.)

the speeds of the aircraft and the carrier, and co-ordinates this information with the wind's speed to give an accurate and reliable reading of the true airspeed of the plane. The landing signal officer uses this information to help him bring the aeroplane safely aboard the carrier.

Several of the aircraft carriers that have had the new Raytheon speed measurement device installed, have reported a gratifying increase in safety through reduced accidents during landing operations. Even without the improved safety for human lives, it was claimed, the dollars-and-cents savings justify the use of the new device. Today's jet fighters cost from 200,000 dollars to half a million dollars apiece, and even a non-fatal accident can cause enormously expensive damages to the plane and the ship.

The speed measuring equipment was described by Raytheon engineers as the first triumph in a project to develop a complete, carrier-controlled system for guiding the approach and landing of aircraft. Someday it may be possible for the landing signal officer to take over and actually fly the plane on its final approach to the deck — even though he is not in the air himself. He would do it by watching the plane's approach via the speed indicator, and operating a set of controls on the deck that are connected electronically to the plane's automatic pilot.

Meantime, the speed measurement device alone is expected to have a tremendous impact on all-weather flying.



Most of the passengers walked away from this DC4 which crashed in USA. Investigators here had plenty of material to work on when analysing the cause of the accident.

AIR CRASHES TELL A STORY

Air travel today is safer than ever before, but occasionally crashes do occur. Each one is carefully analysed to find the cause. No pains or expense are spared, for from the lessons learned may depend the lives of others who travel the airline routes of the world.

INVESTIGATION of aviation accidents and crashes is a most painstaking business involving most comprehensive surveys by skilled technicians whose business it is to discover if possible the cause of the accident.

When an aeroplane crash occurs all the resources of the authorities are brought to bear on the scene of the accident. Any clue which may have a bearing on the matter is carefully weighed and examined. Pieces of the wrecked plane are sought by tramping over many square miles of terr tory. Chemicals, microscopes and x-rays are used to examine the wreckage.

From these examinations the experts are able to determine with a great degree of accuracy the cause of the accident and from the findings have emerged over the past years many improvements to aeroplane design which have reduced the accident and fatality rate enormously.

SCIENTIFIC DEDUCTION

The process of investigation is really a masterpiece of scientific deduction. The technical experts can tell, often at once, whether a piece of the wreckage was torn from the plane while in the air or whether it came adrift when the plane hit the ground.

The reading of a report on a plane crash investigation is very enlightening and shows to what exact details the matter is studied. Such a report invariably begins by giving details of the accident such as location, time and date of the accident, type of flying (passenger, freight, etc.), object of the flight, date and time of notification, date and time of arrival of investigator at the scene.

Then follows a summary of the accident beginning from the time the plane took off from its starting point, what communication took place during the flight, who saw what, where and when, and so on.

WEATHER REPORTS

Comprehensive details then follow of weather conditions from the time of commencement of the journey up to the time of the crash. This weather report deals with flying conditions at commencement, no matter how many thousands of miles away from the scene of the crash, right through the course of the flight. These details are taken, of course, from the records at various airports en route. Needless to say, these weather reports often have a great bearing on the final conclusion as to the cause of the accident.

As instance of this we can site a section of a weather report given during the flight of the ill-fated BOAC Comet which crashed near Calcutta on May 2, 1953, killing thirty-six passengers and crew of six.

This plane was proceeding from Singapore to London. It had arrived at Calcutta and had taken off from there en route to Delhi when it crashed in the village of Jagalgori, twenty-four miles from Calcutta.

An item from the weather forecast issued at Calcutta prior to the flight stated "Storm developing 2410 degrees N 89 degrees E cumulo-nimbus 3000 feet moving southeast direction with very strong vertical updraft". Later a special weather report was issued and transmitted to the Comet in flight but was not acknowledged by the aircraft. This report stated "Thunderstorm accompanied with squalls from north-east speed reaching 50 knots likely Dum Dum (Calcutta) airfield and neighborhood . . ."

INITIAL EVIDENCE

This was the last heard of the plane up to the time of the crash. The main wreckage of the plane was lying in a swamp but much was scattered along a trail of 5½ miles in length.

Investigators were quickly on the scene and discovered the following: There were no scratches on the soft soil where the bits of wreckage had fallen. This indicated that they had fallen in an almost vertical direction with no forward velocity.

The main wreckage had been on fire. The undercarriage was in a fully retracted position. The throttle levers were broken and jammed in the half-open position. All fuel cocks were on. The fire extinguishers had not been used and there was no evidence of emergency procedure being taken. The cabin was being pressurised. This was indicated by the position of the valves operating the spill mechanism. Both extension wings had failed. The top panels of these had failed under tension and the bottom panels had failed under compression. The latter observation was significant, as it indicated that the wing had failed under a download pressure.

The tailplane had suffered damage on the sides by impact. A deposit of smoke was found all along the leading edge of the flap and aileron. A small piece of the rear fuselage was found in the starboard wing.

FULL STORY

The full report runs into many pages but the foregoing are the significant details from which a finding of the cause of the accident was deduced.

The fact that the fire extinguishers had not been used and that no emergency measures had been taken indicated that the plane had not caught fire aloft. The smoke deposit was caused by the detached extension wing falling past the jet blast and thus picking up fire. They had hit the rear fuselage thus causing damage to that.

It would appear that the plane had passed into a violent down gust of air in the thunderstorm. Under these circumstances the plane loses altitude, increases airspeed and assumes a nose down position. The pilot takes measures to correct this position by what is called a "pull up" while the co-pilot throttles back the engines to keep the speed of the craft within the required limits.

By overcontrolling the plane it was deduced that the following train of events occurred. The down draft forcing against the "pull up" of the plane caused a failure of the elevator. This imposed a heavy down load on the wings causing failure of these. The down load is indicated by the top panels being damaged under tension and the bottom panels damaged under compression. That the plane was throttled down is indicated by the throttles being in the half open position on the wreckage.

STORM DANGERS

The broken wings struck the rear fuselage (piece of fuselage in wing) depositing smoke. Fuel from outboard tank ran along the wing span and caught alight on impact.

Thus by a process of deduction the above facts came to light as the cause of the crash. It took a long time to work out and the report covered many pages of closely written foolscap.

Thunderstorms are always a danger to aircraft because of the very strong winds encountered and likely damage by hail. Examination of the wreckage will always disclose hail damage if it has occurred.

The size of the dents in the metal work of the plane will indicate the severity of the storm. Very large dents mean very large hailstones and extremely strong vertical updraft winds.

These strong updrafts can cause erratic behavior of the plane even though no actual damage may occur while in the air. This erratic behavior could cause loss of control and subsequent crash.

MYSTERY CRASH

An accident in America caused some concern to the investigators. Examination of the wreckage revealed nothing to indicate that any part of the plane's machinery or controls had failed in flight. There was no indication of explosion or fire in the air or collision with any other object. There were no signs of hail or lightning damage. All that was found was evidence that portion of the wing had failed and the horizontal tail surfaces had suffered damage. The wing panel had fractured from strain, swung back and wrecked the cockpit cabin.

THIS ONE WAS NOT EASY!

Almost complete disintegration of this aircraft which struck a hillside at night makes detective work difficult and arduous. Fifty-three died in this smash.

by Calvin Walters

For a long time the cause of the failure was not known until the flight analyser instrument was found embedded in the ground. This is an instrument for recording the altitudes of the plane and the time it flew at these altitudes. Examination of this instrument showed that when the accident occurred the recording stylus of the instrument had worked in a reverse direction on the time base line. The instrument will only work this way if it is upside down. It was therefore concluded that the plane must have been upside down at the time of the accident. This particular plane was not designed to fly this way and it had fallen apart.

One of the first lines of attack in an investigation is the examination of parts of the plane to determine whether it fell apart in the air or on impact with the ground.

When a wing or other component shears off in the air the break shows a comparatively clean and even edge. When the part has broken off by impact the break is jagged and bent having the appearance as though it had been twisted off.

LANDING FAULTS

Sometimes a plane will get out of control while landing. When this occurs the detectives examine the ground for such things as a wavy wheel track. This indicates that the wheels suffered "shimmy" such as sometimes occurs in a motor car with badly aligned front wheels.

Propeller marks on the ground are first-class clues in an accident occurring on landing. Sometimes the plane tilts forward and the propeller strikes the ground during revolutions. The distance apart of the marks will show the speed of the plane on landing and how fast the motor was revolving.

Examination of the propellers, if intact after a crash, will often reveal useful information. For instance, if the propellers were not fully feathered when the engines were turned off, severe vibration can occur in the wings.

Engine speed can be determined by the conditions of the propellers after striking the ground. The faster the speed the more the propellers are bent around when hitting the ground.

Ice encrusted between the aileron and the wing can cause a plane to lose control. This ice is useful information if the investigators get to the scene quickly enough.

Another useful speed indicator is the pattern of the wreckage distributed over the ground. When the plane hits, some of the wreckage must be propelled forward. The faster the plane had been travelling the farther the wreckage must be thrown. Laws of physics play an important part in such investigation. Mathematics also come into the picture to determine the speed. Any wreckage found behind the wrecked plane must obviously have come off the plane in the air.

An instance of good detecting took place in the investigation of one crash which established that the plane had caught fire in the air. It was established that the fire occurred rear of the cockpit but the cause was a bit of a poser.

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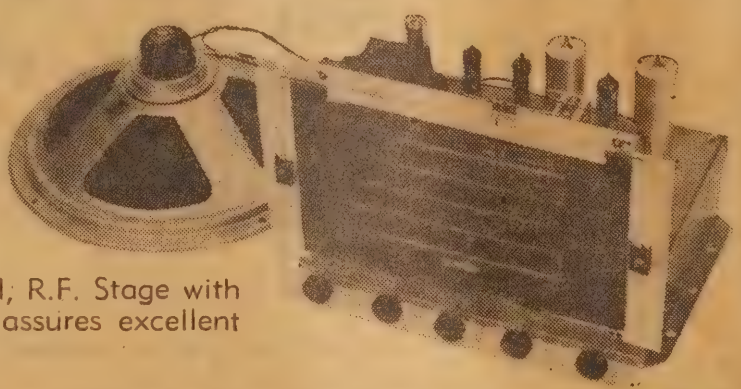

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The investigators secured an identical plane and took it on a flight while they made a thorough inspection. They noticed some brass studs which held electric cables against the inside of the fuselage.

Digging around again among the wreckage of the crashed plane they found some identical studs which showed evidence of intense heating by electric current and not by fire alone.

Current from the electric cables had quite obviously arced over on to the studs, setting fire to the soundproof material lining the fuselage. The flames had been fed also by hydraulic fluid which leaked from pipes running alongside the electric cables. The hydraulic pipes had burst from the heat.

DIFFICULT CASE

Another crash killing 21 passengers and crew was the scene of intense and laborious investigation. The plane had burned almost completely on crashing and it appeared that little could be done to arrive at the cause of the disaster. The propeller blades were found buried in six feet of mud and the engines were removed after three days work by bulldozers, so deeply were they buried in the ground.

The only previous clue the investigators had was that the pilot had radioed that he was having engine trouble.

Examination of the cockpit showed that the ignition switch for that engine was off and the mixture control set in the cut-off position. The cockpit controls were set for left engine operation.

Although examination of the right engine revealed no mechanical failure it was obvious that that engine had for some reason been shut off and the plane was running on one engine only.

The cause of the crash was finally discovered in the left engine, for when this had been taken apart it was found that the cam and rocker arm mechanism to one cylinder was faulty and had been faulty for some time before the crash. It was impossible for a heavy plane to continue on one engine with a faulty cylinder.

Sometimes plane crashes can only be attributed to probable causes. An instance of this was a crash in a wheatfield. No evidence of structural failure had been found or any mechanical defect. One of the engines was found 1200ft ahead of the point where the plane crashed.

UNUSUAL SPEED

The plane had also sheared off progressively longer wheat stalks during its crash to earth. This enabled the investigators to determine its trajectory and speed. A line drawn along the tops of the wheat stalks enabled this to be determined.

It was determined that the plane had been travelling at a speed of 300 miles per hour, or 120 miles per hour greater than normal.

This indicated that for some reason the pilot had opened the throttles flat out.

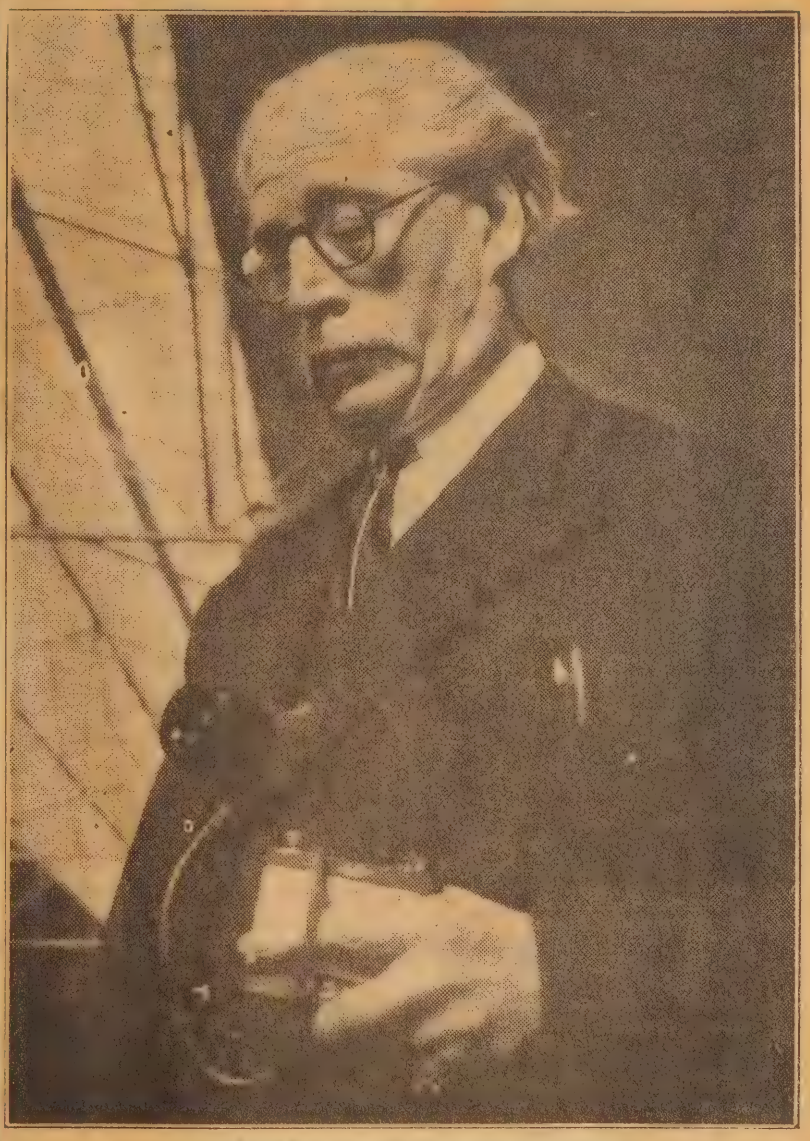
An eyewitness stated that there had been a terrific flash of lightning in the vicinity of the plane.

A surveyor's transit instrument was used to determine the height of the plane in relation to the probable position of the lightning flash.

Although no definite reason could be deduced of the cause of the high speed, it was assumed that the aeroplane was in some way affected by the lightning flash or the pilots had become disabled by it.

All these investigations are having a far-reaching effect on air safety, as they enable designs to change according to the defects found from time to time. By it air accident rates have been reduced to a fraction to what they were some years ago.

ARTIFICIAL SIGHT FOR BLIND



M. Saint-Quentin with his electronic camera.

MANY devices have been evolved to bring artificial sight to the blind, or at least some type of electronic warning.

M. Sademant de Saint-Quentin, a French scientist, has developed an unusual approach to the problem. An electronic camera of small size is used, powered by a pocket battery of 4.5 volts.

The camera throws an image on a plastic screen having photo-electric properties and connected by a cable to the camera. The screen is held in contact with the skin, either of the breast or the forehead where it acts like an artificial retina. Due apparently to a reaction on the nerves of the skin, the blind person, through his sense of touch, gains an impression of the nature of object in front of him.

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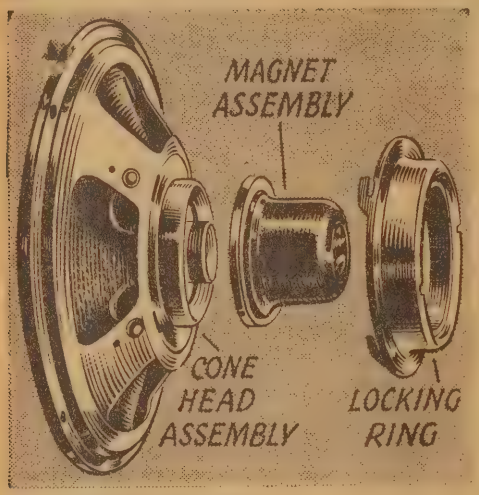

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Technical Review

ELECTRON-BEAM HEAD FOR MAGNETIC TAPE PLAYBACK

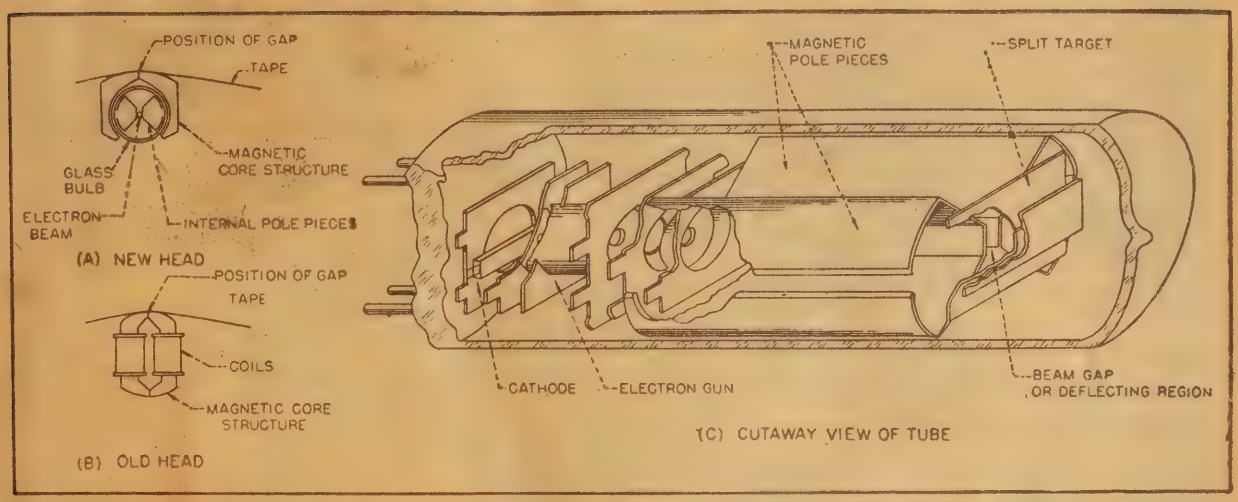


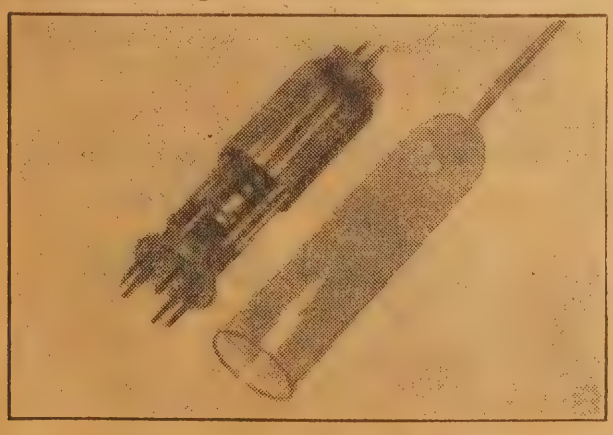
Fig. 1 Cross sections of new and conventional magnetic tape playback heads, and cutaway view of the cathode-ray tube used in new head.

Standard magnetic tape run over neck of special miniature cathode-ray tube causes electron beam to deflect between two collecting plates alternately at the recorded audio rate, so that current output of tube is linearly proportional to magnetisation on tape.

SINCE the time of Poulson's invention of magnetic recording more than 50 years ago only one principle of reproduction has been employed. This is the generation of a varying electric current in a coil by the variations of magnetic flux from the tape.

A disadvantage of this kind of reproduction lies in the fact that the output signal is proportional to the rate of change of the flux in the tape rather than to the instantaneous values. The resulting frequency characteristic increases from zero linearly until limited by the gap size. Since flux here is directly proportional to the input signal, the output from a conventional head is not a true reproduction of what was recorded. Equalising networks must be incorporated in the reproducing circuits to restore the balance between low and high frequencies so the reproduction will sound like the recorded signal.

In the new pick-up head described herein, the magnetic flux in the tape is guided by a magnetic structure into a tiny cathode-ray tube where it deflects the electron-beam in proportion to the instantaneous magnitude of the flux. The magnitude of the output signal is independent of the recorded frequency and of the speed of the tape. In fact, if the tape is moved very slowly or even stopped altogether the amplitude of the output signal is not decreased. The tube also acts as a deflection type of amplifier, giving output voltages many times those from conventional heads.



☆

Tube structure and bulb before sealing.

Figure 1A shows a sectional view of the new type of reproducing head, with the old type shown in Fig. 1B for comparison. The new head has a conventional gap in contact with the tape, and a magnetic core structure which guides the flux through the glass walls of the tube. The internal magnetic pole pieces carry the flux into the deflecting region where it produces a magnetic field that deflects the electron beam.

Figure 1C shows a cutaway view of the tube. The miniaturised electron gun at the left sends a beam of electrons between the pole pieces toward the split target. The deflection of the electrons is at right angles to the flux and hence parallel to the pole faces.

This property of magnetic deflection is advantageous in increasing

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the sensitivity since the pole pieces never get in the way of the defected beam. The pole pieces are thin molly-permalloy and the other metal parts of the tube are non-magnetic stainless steel.

Figure 2 shows the basic circuit connections. The small plate located just behind the slit between the target plates is grounded to repel those electrons that pass through the slit and thus reduces the effective slit width. For zero flux and zero deflection, the beam is equally split between the output plates of the target, giving zero output voltage across the 100,000-ohm load resistors.

In operation the beam swings back and forth between the two plates depending on whether the flux is negative or positive. When the beam is deflected the target currents are no longer equal and hence a net output voltage is developed across the two load resistors.

The output characteristic in Fig. 3 shows output voltage measured across the output plates for different values of flux in the beam-gap. The characteristic is linear over a range of plus or minus 1 gauss. This range is about 50 times greater than the maximum flux varation from standard ¼ inch magnetic tape when used with the complete head under typical operating conditions.

MAGNETIC STRUCTURE

The magnetic head structure design of Fig. 1A, was abandoned early in the work, in favor of the strip-type magnetic structure shown in Fig. 4. The magnetic gap caused by the deflecting region in the tube introduces a very high reluctance, making the reluctance of the elements in the magnetic circuit negligible in comparison with the beam-gap reluctance. The magnetic elements may, therefore, be reduced to the smallest practical dimensions without appreciable loss of flux. A single lamination of Mu metal 0.014-inch thick proved to be adequate.

The strip-type structure is assembled by using Hysol thermo-setting casting resin, which has good adhesion to the metal and is easy to handle. A molybdenum spacer 0.0003-inch thick controls the pick-up gap. The wings of the head extend out in the direction of the tape to increase the effective length of the magnetic core, and also act to extend and flatten the low-frequency response of the pick-up, for improved performance.

To determine the flux density at the electron beam, a calibrated vibrating probe was used to measure the flux density in the gap between a pair of dummy pole pieces mounted in proper relation to the external magnetic structure. With a saturated tape recording, a field intensity of approximately 0.04 gauss was available for deflection of the electron-beam.

Reluctance and leakage factors of the various portions of the magnetic circuit were determined by additional measurements and calculations. Using these values, it was shown that the total flux in the beam gap should approximate 8 pc of that available from the recording. The cross-section area of the magnetic tape coating was approximately 1/1200 that of the beam gap. A saturated recording on a typical tape having a retentivity of 600 gausses should provide a beam-gap flux density of 600 x 0.08 x 1/1200 equals 0.04 gauss, which is in agreement with the earlier measurements.

Tube sensitivity was determined by measuring the tube voltage output per gauss of beam-gap flux density.

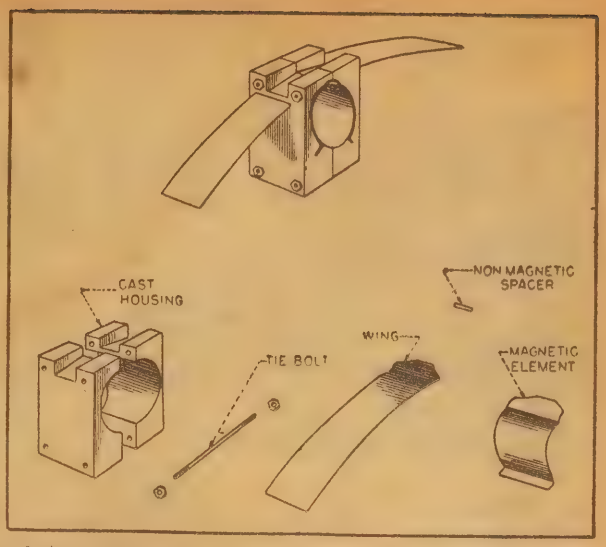

Fig. 4. Components and assembly of experimental winged core used with new head.

With the sensitivity of the tube equal to 15 volts per gauss and a beam-gap flux density of 0.04 gauss, a maximum output voltage of 0.6 volt peak, plate-to-plate was expected. Tests with recordings on tape confirmed these figures within experimental error.

FREQUENCY CHARACTERISTICS

These figures indicate the high sensitivity of the cathode-ray tube. It will give satisfactory output voltages on field strengths from one-tenth to one-hundredth the strength of the earth's magnetic field.

Curve A of Fig. 5 gives the frequency response of the new head without any equalisation. Curve B, shown for comparison, is the frequency characteristic of a conventional pickup head, also without equalisation. It should be noted that the scales are quite different for curves A and B. For example, the maximum output obtained by the conventional head is only 10 millivolts, whereas the level of most of the frequency range of the new head is about 0.2 volt. These curves were taken with conventional longitudinal recordings, and demonstrate the superior low-frequency performance of the new head.

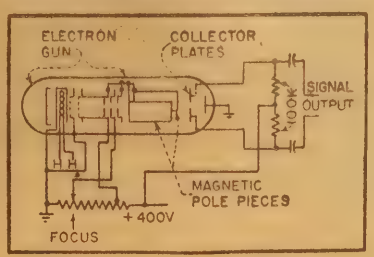

Fig. 2. Cathode-ray tube circuit.

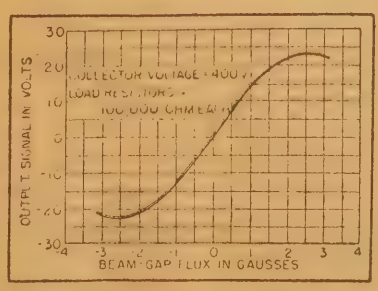

Fig. 3. Output characteristic of new electron-beam playback head.

At the upper-frequency end of the curves the deterioration in output is caused by the so-called gap effect, which comes about because the gap itself is comparable in length with the wavelength of the recorded pattern. The curves show that this effect is more serious with the new type of head. The reason is that the steeply ascending curve of the conventional head partly compensates for this gap effect, whereas the flat characteristic of the new head has no compensating feature.

Calculation indicates that a simple single-section R-C equalising network used in conjunction with the new head, will modify the characteristic to curve C. A two section R-C filter will give an even better effect, as shown by curve D.

MAGNETISATION PATTERN ON TAPE

All of the discussion given above was based upon conventional longitudinal recording on the tape. For very low frequencies, corresponding to long wavelengths in the tape, this is not the optimum type of recording pattern. For the long wavelength the gap has access only to the leakage flux near the centre of the elementary magnet; therefor, as the head is moved slowly over a long recording, such as for a square wave, the response will be a maximum at the ends and a minimum at the centre of the square pulse.

Either perpendicular or transverse magnetisation would be more suitable, but both of these suffer at the high-frequency end. The work to date has been restricted in general to longitudinal recording since the overall response was more important than the low-frequency end of the spectrum.

Work is being carried on, however, on perpendicular recording in-

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INTERCHANGEABLE HEAD TYPE. Designed for use with the standard 78 r.p.m. or 33 1/3 r.p.m. long-playing microgroove records. To meet these differing requirements interchangeable slide-on heads or cartridges are available. There is definitely nothing comparable with this pick-up.

It is new in pick-up design, has 20 times greater output than comparable magnetic types, and automatic bass response while needle talk and motor rumble are practically non-existent.

Price £7/19/6
INCLUDING BOTH STANDARD & LP CARTRIDGES

The Acos Model HGP.34 Turnover Type Pick-up is fitted with the new and radically different HGP33 crystal cartridge. Output nominally 1 volt on standard records and ¼ volt on L.P. records. The response characteristic is smooth with no resonance. (Data sheet gladly forwarded on request.)

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(for GP.20 Standard) GP 19 **£2/18/6**
(for GP.20 microgroove) GP.19L.P. **£2/18/6**
(for GP.30 Turnover) GP.29 **£2/18/6**
(for GP.10 Standard) GP 9 **£1/11/6**
(for HGP Turnover) HGP.33 **£3/16/-**

The HGP.33 crystal cartridge is a high compliance cartridge which is used in the Model HGP.34. The salient points of this cartridge are:—Extremely high compliance and low mass; Completely hermetically sealed crystal unit; Universal mounting.

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volving magnetisation through the tape. Indications are that this may be made to give much superior results at the low-frequency end without too great a loss at the high-frequency end of the spectrum.

This new type of head offers advantages over conventional heads in a number of uses. In spite of the excellent results obtained with well-equalised conventional recording of music, it is believed that ultimately the quality obtained with the new head will surpass that possible with conventional types.

There are certain commercial and military applications where it is desirable to record very low frequencies, d-c levels or pulses without distortion. For these the new head is ideally suited, whereas the old type will not perform adequately without considerable complexity of the apparatus, such as the dithering head and the use of frequency modulation for d-c recording.

This development has been sponsored by the Bureau of Ships of the United States Navy under Contract Nobsr-57452. The tube has been under development at National Union Radio Corp., and the magnetic head structure at Stromberg-Carlson Co. This paper was presented at a meeting of the Institute of Radio Engineers in San Antonio, Texas on February 7, 1953.—ELECTRONICS.

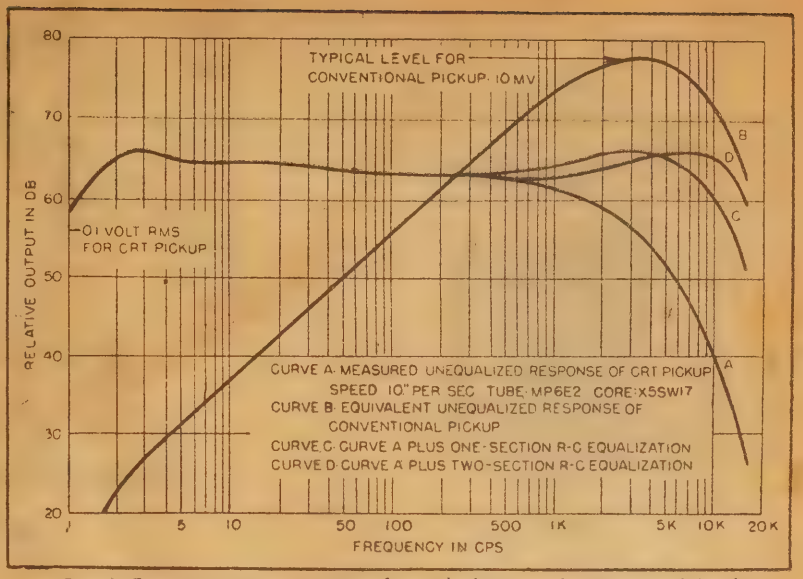

Fig. 5. Frequency response curves for cathode-ray and conventional heads.

ENGINEERS WHO DRILL FOR OIL

(Continued from Page 7)

reduce this to a minimum. The high cost of drilling and keen competition has resulted in the training of skilled workers whose one object is to keep the non-productive time down to an absolute minimum.

These men are trained—and work—as a team. Each man knows exactly what he has to do and exactly when to do it. He also knows exactly what his team-mate is going to do and when, and times his own movements accordingly. The result is an example of split-second timing, co-ordinated movement, and precise handling which would do credit to an army gun crew and which, in fact, it closely resembles.

An even bigger job than that of lengthening the drill string is withdrawing the bit from the bottom of the hole. This becomes necessary from time to time for various reasons, the main one being to replace a worn or damaged bit.

Quite obviously the bit can only be brought to the surface by removing the entire drill string, which may be anything from a few hundred feet to 20,000 feet or more in length. This means that something like the reverse procedure to that of adding pipe must be undertaken until the entire string has been broken up and stacked.

However, to save time, the drill pipe is normally broken at every third or fourth joint, preferably the latter, rather than at every joint. This means that the pipe is handled in 90ft or 120ft lengths and it is stacked upright inside the derrick on special racks. It is the need to handle such long sections of pipe that makes necessary the very high tower.

For this operation the kelly is completely removed from the string and stood upright in a hole prepared for it. This is known as the "rat hole" A special grip on the hoist is then used to couple directly to the drill pipe and haul it out several lengths at a time.

In spite of the time saved by handling multiple lengths of drill pipe, the withdrawing of a bit is a lengthy process and calls for the same precise teamwork as does the adding of pipe if it is to be done in a reasonable time. Even so, it is not unusual for more time to be spent withdrawing and replacing the bit than on actual drilling, particularly when the hole is deep.

Eventually (it is hoped) the drill will strike oil. This may be present in various forms and show itself accordingly. It may be held in suspension in sand; it may be free and under moderate pressure; or it may be free and under considerable pressure.

The first condition is similar to the one at Exmouth Gulf, where the drill encountered oil-bearing sand at a little more than 3000ft. This is incapable of rising to the surface of its own accord and was first detected in the cuttings brought to the surface by the mud. Later, test containers were lowered into the sand and the time taken to fill them through a given diameter opening noted.

Thus it can be appreciated that the present find is valuable mainly as an indication that oil could be present in much larger quantities at a greater depth or at some other site. The find is not regarded as having any direct commercial value.

In the second case, free oil under moderate pressure, it is likely that the weight of mud would hold the oil in check and the first signs would be observed in the mud coming from the bottom. In such cases the mud would be left in the hole to act as a plug until a metal pipe or casing can be passed down into the oil-producing zone and cemented in place. Thus the oil is controlled at all stages.

Where the oil is under considerable pressure it is likely to force its way to the surface in spite of the mud and threaten to "run wild", with the risk of serious damage or waste if it is not controlled. To guard against this the conductor pipe at the top of the hole is fitted with special high-pressure valves which can be closed quickly in the event of trouble.

In any case, assuming that the find is a payable one, the hole will need to be lined in some way to protect it from cave-in. This is usually done by passing the required diameter pipe down the hole to the oil level, then forcing cement through the pipe so that it flows out the bottom and up the outside of the pipe to the surface.

The pipe is kept full of mud until the cement has set, after which it is removed and the oil allowed to flow up the pipe. The necessary control valves having been fitted, it is now a simple matter to control the flow, and the oil is piped to whatever form of transport—road tanker, ship tanker, pipeline, &c.—conveys it to the nearest refinery.

Big Jets are Noisy

AIR FORCE men say the whine of America's new giant B-52 Stratofortress jet-bomber is the loudest noise they have ever heard.

Its eight engines are the most powerful in the world.

Still on the secret list, the new war plane has been put into full-speed production at the Boeing factory in Seattle. A prototype model known as the YB-52 was test-flown recently before a group of newspaper correspondents.

An idea of what the monstrous YB-52 looks like can be gleaned from these measurements: Weight, more than 300,000lb; wing spread, 185ft; length, 153ft, and height of its vertical tail fin, 48ft above the ground.

The flaps on the wing are equivalent to the size of one whole wing section on the DC-3 transport.

Precision drawn in Australia to conform to highest world standards

PHILIPS

Fine Wire

Gauge B&S	Gauge SWG	Nominal Conductor Dia. in Ins.	Enamelled S. or D.	Cotton S., D. or T.	Silk S., D. or T.	Rayon S., D. or T.
32		.0080	x	x	x	x
	36	.0076	x	x	x	x
33		.0071	x	x	x	x
	37	.0068	x	x	x	x
34		.0063	x	x	x	x
	38	.0060	x	x	x	x
35		.0056	x	x	x	x
	39	.0052	x	x	x	x
36		.00500	x	x	x	x
	40	.0048	x	x	x	x
37		.00445	x	x	x	x
	41	.0044	x	x	x	x
	42	.0040	x	x	x	x
38		.00397	x	x	x	x
	43	.0036	x		x	x
39		.00353	x		x	x
	44	.0032	x		x	x
40		.00314	x		x	x
41	45	.00280	x		x	x
42		.00249	x		x	x
	46	.0024	x		x	x
43		.00222	x		x	x
	47	.0020	x		x	x
44		.00198	x		x	x
45		.00176	x		x	x

THE world-wide reputation that Philips have achieved for high quality fine wire is more than adequately maintained with the fine wire now being produced at Philips Hendon Factory.

The most rigorous testing methods are employed to produce wire of a uniformly high standard. Before despatch all wire is tested for dimensions, pinholes, break down voltage and enamel quality.

The range of Philips Australian-made fine wires includes: Single core enamelled copper wire from 32 B&S and 36 SWG. (see table opposite), high frequency Litz wire, multi-strand flexible, and others within the fine wire range; write for illustrated folder containing complete details and specifications.

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PG9-53

NEWS AND VIEWS OF THE MONTH

Reception via meteors

DR. OSWALD VILLARD, of Stamford University, is carrying out an unusual investigation on behalf of the US Navy. He is interested in the effect of meteors on short wave reception.

It is claimed that the continuous shower of small meteors which arrive at the earth's atmosphere from outer space causes an electrified layer about 70 miles high, quite distinct from the recognised layers which reflect radio signals back to the earth and provide long distance short wave communication.

He says that there is a constant stream of meteors, mostly no larger than grains of sand, and that the rate of their arrival is approximately constant.

When the meteors strike the atmosphere they are instantly consumed by the heat generated through friction with it. As a result the air particules become ionised.

By using reflections from the layer so formed, reliable communication is forecast over 1000 miles for 24 hours per day.

Although no mention of it is made in this report, it is interesting to speculate whether such a layer would account for many VHF signals which have been regularly observed over distances much greater than allowed for by generally accepted theory.

Recently, successful experiments were carried out by using a very high powered station of about 5 meters wavelength and observing reception from it for distances of about 1000 miles. The signals were not very strong, and had obviously suffered great attentuation on the way, but they were remarkably constant in strength. The general idea was that the signals were the result of "scatter" from ionised atmosphere which ensured that a small portion of the radiated power travelled a given path all the time.

The result would tally fairly well with the idea of a substantially constantly ionised layer, the existence and height above ground of which does not materially alter either with light and darkness or with the change of the seasons.

Meat keeps 4000 years

WHEN a tomb at Jericho, closed 4000 years, was opened this year by a woman archeologist, joints of meat were found which had resisted drastic deterioration since the tomb was sealed.

Leader of the expedition, Dr. Kathleen Kenyon, director of the British School of Archeology in Jerusalem, plans to take a research chemist with her to analyse the meat.

The tomb was excavated 20 feet below the ground at the foot of a shaft, and was hewn out of solid rock.

It contained wooden objects, portions of clothing and rush mats, and the joints of meat as offering to the dead.

Dr. Kenyon said, "The skin was intact on top of the liquid originally placed in storage jars.

"As soon as the tomb opened everything in it began to ooze moisture.

"If, when we return to Jericho, we can take with us a research chemist, he should have a better chance of analysing the food, drink, textiles and other things we may find.

"The meat, for instance, had gone only spongy, after all those years."

"A chemist could tell us a lot before we try to move things from the atmosphere which has inexplicably preserved them for so long."

Rescue bell for subs.

SOME of the worst naval distasters apart from actual warfare have been caused when, through some technical fault, diving submarines failed to come to the surface.

In many instances, the vessels had been in water too deep for a diver to operate, and for the crew to escape through the hatch. Their companions on the surface have had the agonising experience of standing helplessly by knowing there was nothing they could do.

The British First Lord of the Admiralty Mr. J. P. Thomas has announced that a new diving bell has been developed for use when subs are trapped below.

Mr. Thomas said the Navy would fit the bell to its salvage vessel. King Salvador.

In the emergency the salvage ship would lower the bell by winch over a sunken submarine.

The rescue chamber would carry a crew of two or four who would clamp the chamber to the submarine's escape hatch, then signal the men inside the submarine to open their side of the hatch.

The rescue crew would regulate

POPULAR SCIENCE QUIZ

Q. What is "photoperiodism" as applied to animals and plants?

A. The relative length of night and day has effects on plants and animals, the outcome of which is called "photoperiodism". Differences as small as 15 minutes in the length of day or night can be the signal for birds to fly thousands of miles or for plants to cease growing and to begin to flower.

Among the higher animals, light and darkness are perceived, generally, through the region of the eyes. The light stimulates the optic nerve which, through cerebral centres, then stimulates the hormone-producing pituitary and, perhaps, other hormonal glands. With lower animals, light may be perceived through the optical region or, in some cases, through the thin body wall, to activate hormonal responses. Broadly, this is the way that light-change sets off the mechanism of seasonal changes in these animals.

In plants, the action of light changes seems to operate mainly on the leaves. Experiment, still under way, indicate that the light changes act on a pigment in the leaf to produce many of the photoperiodical effects observed. The pigment has not been isolated chemically as yet.

The effect on living beings of this relation of the length of night to day is complicated by the fact that the same stimulus of light or darkness can lead to opposite or totally different phenomena in different species.

Q. When milk is exposed to sunlight it develops an "off" flavor. Why is this?

A. According to findings at the Pennsylvania Agricultural Experiment Station, State College, the unpleasant flavor and vitamin loss that occurs in milk left standing in conventional glass milk bottles in sunlight for a half hour or more results from the chemical change of methionine, one of the amino acids in milk, under the action of solar energy.

This effect is intensified by the riboflavin, the B vitamin, also a natural constituent of milk. In the course of the reaction, a substantial portion of the riboflavin is destroyed. Most of the vitamin C in milk is also destroyed by solar energy but it is not stated whether this is related to the methionine change or is a separate effect.

Q. What is the estimated age of the earth?

A. The chemical, lead tetramethyl, was used by the scientists of the University of Toronto to show the age of the earth's crust as 3500-million years. They also found that the earliest time at which all of the elements could have been formed was 55,000-million years ago.

All thorium and uranium minerals are radioactive and decay over a long period to lead. Though this lead looks and reacts like ordinary lead, it is an isotope of ordinary lead and is found mixed with ordinary lead in minerals. Because it results from the radioactive decay of thorium and uranium minerals, the amount of the isotope present is an indication of the age of the mineral. To detect the amount of the isotope in minerals, it was made into lead tetramethyl and the compound analysed in a mass spectrograph. This was done for many samples from all over the world to deduce the time of formation of the earth's crust and the maximum time of formation of the elements.

NEW NEW

Agfa

MAGNETON TAPE FS.

TECHNICAL DATA

SENSITIVITY: The Agfa Magneton Tape FS for tape speeds of 19 and 9.5 cm/sec. (7½in and 3½in/sec) has a sensitivity of plus 14 plus/minus 1 db for 1 kc/s, measured at 76.2 cm/sec, optimum premagnetization and related to the standard broadcasting tape (plus/minus 0 db).

FREQUENCY RESPONSE: The Agfa Magneton Tape FS has a frequency response of at least plus 5 db.

DISTORTION FACTOR: The distortion factor is lower than 0.5 per cent, measured as proportion of the 3rd harmonic (3 kc/s) of 1 kc/s. Thus the low distortion factor of the "FS" Tape ensures a particularly good and undistorted reproduction.

MODULATION NOISE: 30 db.

Available from Distributors and Dealers throughout Australia

SOLE IMPORTERS: HENRY H. YORK & CO. PTY. LTD., MELBOURNE — SYDNEY

air pressures and help the trapped men to climb into the bell.

Mr. Thomas said Navy volunteers had carried out dangerous experiments from the salvage ship Reclaim on a mock sunken submarine on the seabed.

Salvage experts in Reclaim's control-room watched each stage of the underwater experiments on the Admiralty's television system.

The major problem still to be overcome was the rescue of the crew from a sunken submarine lying side-up on the seabed.

Flying TV stations

SINCE the early days of television flying stations have been mooted to extend effective range.

Normally television signals have restricted coverage, not because they are television, but because they use very short wavelengths, the propagation characteristics of which are similar to those of light waves for strong, reliable signals.

The higher the TV aerial is sited, the larger will be its range before the earth's curvature sets up a "shadow". Obviously an aircraft carrying a TV transmitter and flying some miles above the ground will enormously extend the useable range.

Now the Americans are to begin further experiemtns with flying TV stations.

These are planes which will circle over France and send programs into Britain.

It is expected these experiments, based on a method invented in Britain, will start almost immediately.

Object will be to see how far into Britain flying TV can penetrate.

Test pictures will be picked up by special sets.

If the plan is successsful British manufacturers would get orders to make special sets for the public.

A commercial TV expert said, "It would not be an expensive process.

"There is an enormous library of telefilm ready in New York."

Atom power essential

WITHOUT the use of atomic energy as a source of power, the world population will by the end of this century be faced with a power deficiency which will lead to a stagnation or lowering of the general standard of living.

This was stated by Dr. Gunnar Randers, head of the Institute of Atomic Energy in Oslo, in a lecture given by him to the Economic Society in Oslo.

Fortunately, said Dr. Randers, the results of uranium-reasearch have assured that atomic energy will be able to take over power supply, and the amount of uranium known to exist today is large enough to ensure supplies for 200 years after the year 2000.

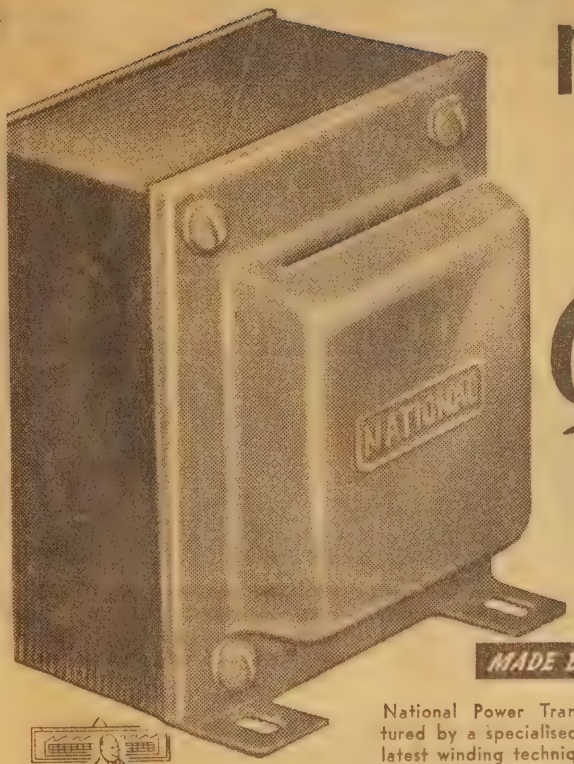
The question as to what extent atomic energy should be used for commercial purposes is an economic one.

★ ★ ★

THE bigger you are, the better you can stand radiation, from x-rays to atom bombs according to British scientists doctors.

They find that the larger the person, in weight and body surface area, the longer the period after irradiation before acute symptoms of radiation sickness set in. And the longer this period, called the latent period, the shorter is the period of acute symptons.

They must be Good



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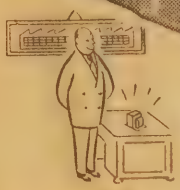

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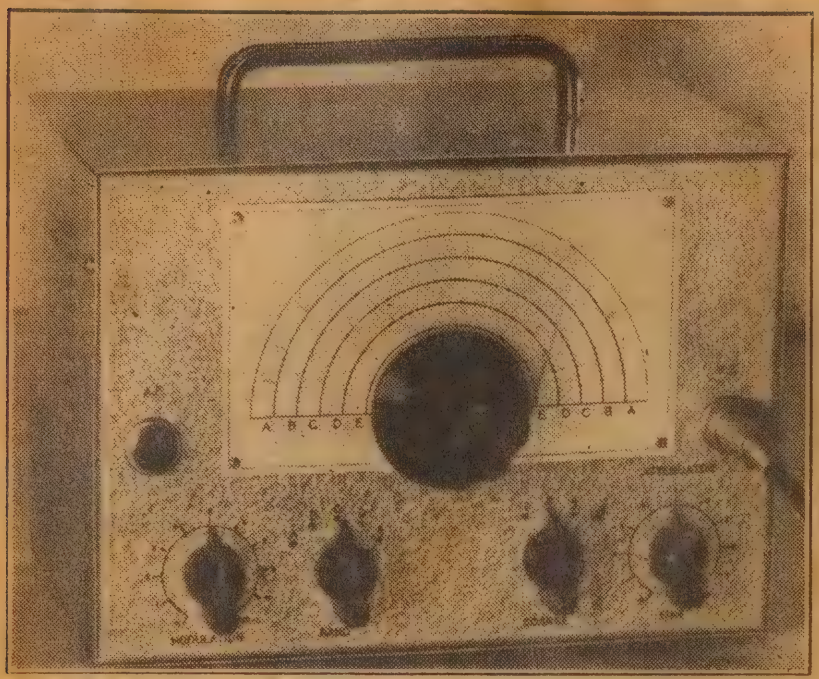


A front view of the oscillator mounted in a standard small instrument case. The large centre knob sets the frequency on each band while the controls along the bottom from left to right are: modulation depth, band selector, coarse attenuator and fine attenuator. The RF output socket is above the attenuator and the AF output socket opposite to the left.

A NEW MODULATED OSCILLATOR

A good modulated oscillator is not only essential for radio service work, but is extremely useful to any home builder. This simple design, made to fit our standard instrument case, should give you no constructional trouble. It has several interesting circuit features which avoid some of the faults inherent in simple instruments.

by Maurice Findlay

THE simplest type of oscillator which is at all useful for general radio servicing work consists of a radio frequency oscillator modulated by an audio frequency oscillator. A set of switched coils and a tuning capacitor enable the radio frequency oscillator to operate over the required range, usually from about 150 Kc to 30 Mc.

The audio frequency oscillator is adjusted to operate at a fixed frequency of about 400 cps. and amplitude modulate the RF oscillator to a depth of about 30 pc.

MODULATION METHODS

In the case of a triode RF oscillator, the plate supply can be varied at an audio rate and the strength of the radio frequency signal will vary in sympathy.

Where a pentode is used, the cathode, control grid and plate of a can be made to behave as the cathode, control grid and plate of a triode. The modulating voltage can then be applied to the suppressor grid. Output is taken from the plate where it appears as RF modulated by the 400 cps. audio.

With this arrangement, the frequency controlling circuits are less intimately connected with the modulation, with the result that there is a general overall improvement in performance

The radio frequency at which the triode oscillator operates is to some extent dependent on the plate voltage as well as the constants of the tuned circuit. The result, when the plate voltage is varied at an audio rate for the purposes of modulation, is that in addition to the signal varying in amplitude, it tends to vary in frequency. To a lesser extent the same is true of the suppressor modulated pentode.

When tuned in on a receiver, a signal containing frequency modulation components as well as amplitude modulation appears "broad". It is difficult to find a setting of the receiver dial which will give maximum audio output from the receiver.

In some cases, two or more settings which give nearly the same amplitude can be found.

With such an instrument, the task of aligning a receiver becomes very difficult and the result is often not very accurate. Even if the modulation is switched off and alignment effected by connecting a vacuum tube voltmeter across the AVC line, there are likely to be inaccuracies due to Miller Effect, as the signal has to be relatively strong in order to obtain a workable deflections of the VTVM.

The accepted procedure is to work with a weak, modulated signal and align the receiver by means of an audio output meter. It is essential then to have a stable signal free from frequency modulation.

While the suppressor modulated pentode does provide an acceptable signal for alignment in many cases an improvement is well worthwhile if it can be obtained without too much difficulty.

One simple way to overcome the frequency modulation is to use the oscillator to drive an amplifier and apply the modulation to the amplifier rather than the oscillator. In its general concept, the idea is similar to that used in many small transmitters.

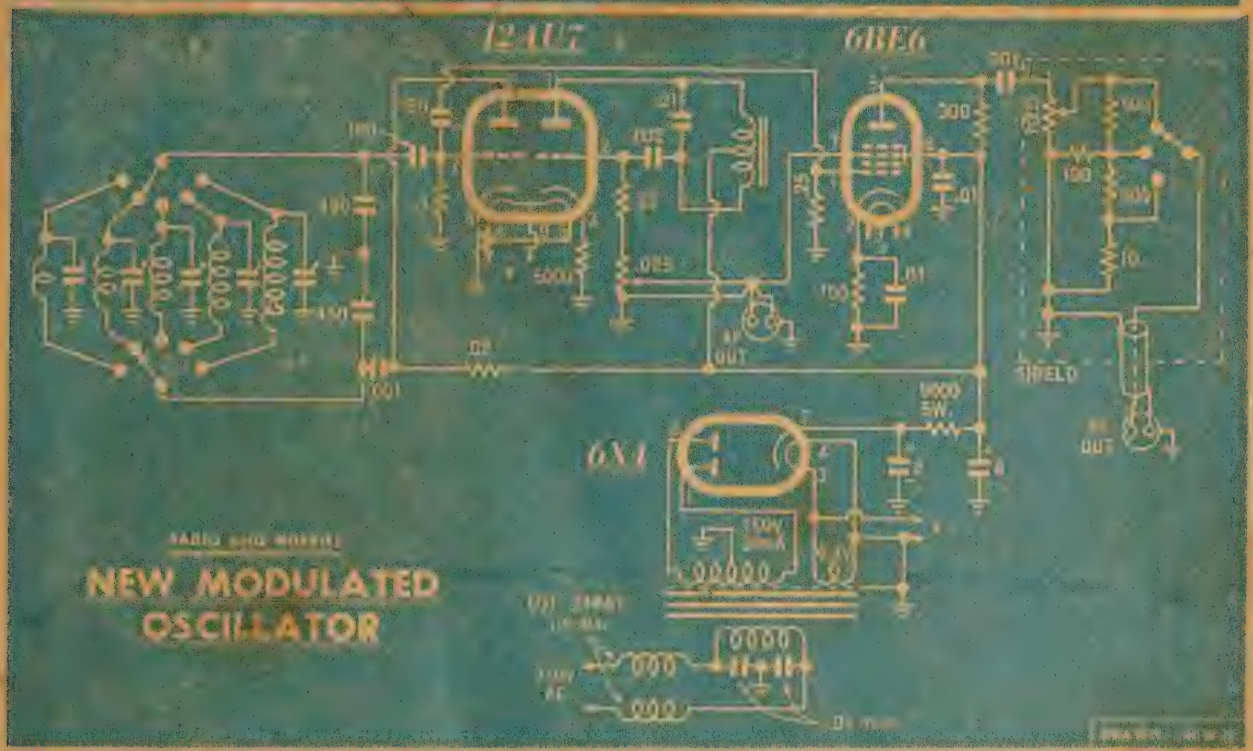
In this case the amplifier has to work over a wide range of frequencies. The output requirements are not great and in fact there is no objection if the amplifier actually gives a slight loss. It is desirable that the gain be reasonably constant over the range, but even this is not essential.

6BE6 MIXER

We found that results were excellent with a miniature pentagrid converter type 6BE6 operated with a very low plate load resistance. With a 300 ohm plate load the valve actually gives a small loss in gain. This loss is fairly constant over the range from 150 Kc to 30 Mc because the load is low, compared with the reactance of valve plus stray capacities, up to about 30 Mc.

The radio frequency signal from the oscillator valve is applied to the inner grid of the 6BE6. (This grid is normally used as the oscillator grid.) It modulates the electron stream in the usual way and a voltage corresponding to the original signal appears across the plate load resistor.

CIRCUIT DIAGRAM OF NEW MODULATED OSCILLATOR



One section of the 12AU7 is used as the RF oscillator, the other as the audio oscillator. Both signals are applied to the 6BE6 where the RF signal is modulated by the audio. Alternative types for the 12AU7, 6BE6 and 6X4 are 6SN7-GT, 6SA7 and 6X5-GT respectively. No changes in circuit constants are required.

The 6BE6 contains another control grid which has a screening grid on either side. When the valve is used in normal converter service, the radio frequency signal from the aerial is fed into this grid. In our case, the signal from the audio frequency oscillator is fed into this control grid where it again modulates the stream of electrons from cathode to plate.

The advantage of the scheme is that the modulation is applied to the RF signal with negligible effect on the oscillator. Thus the amplitude varies but the signal remains substantially constant in frequency.

The principles are well known in engineering circles and in some of the more expensive instruments similar arrangements are made. The 6BE6, and its octal based equivalent the 6SA7, appear to be excellent for the purpose because of the good screening between the two control grids. Another valve which provides similar facilities is the 6L7.

SIGNAL GENERATOR APPROACH

A number of well engineered commercial signal generators employing modulated amplifiers are available often with a built-in vacuum-tube volmeter to measure the output voltage of the signal and an accurate attenuator.

So that the calibrated attenuator is of real value if the leakage of the signal from the case is made very low.

In addition, a good signal generator would boast a fairly accurate dial. It may or may not have facilities for varying the percentage and frequency of modulation.

For a laboratory where orginal design work is undertaken such an instrument is essential. However, for ordinary maintenance work on radio receivers such facilities are a hindrance rather than a help because they make the instrument larger physically and more difficult to operate. There are plenty of busy servicemen who will support the latter statement.

Granted, the leakage of a service oscillator must be low at least up to about 2 Mc so that controllable weak signals can be provided for the alignment of broadcast receiver RF and IF channels. Some leakage at high frequencies is not so serious because the high frequency circuits of receivers are not so critical.

A simple attenuator consisting of a potentiometer and a voltage dividing network such as we have used in our new oscillator is capable of doing an excellent job within these specifications. A shield is placed around the attenuator to isolate it from the other circuits within the case and in our instrument the attenuation is quite good up to about 5 Mc. Even above 5 Mc. the leakage compares favorably with many commercial instruments of similar type.

The accuracy of the frequency calibration should be sufficiently good to enable the receiver dial to be calibrated in the absence of sig-

PARTS LIST

1 Instrument case 9in x 6½in x 5½in.
1 Chassis 8in x 6in x 2½in.
1 Power transformer 250-0-250v at 6.3v.
1 Small 2-gang capacitor (MSP type 18623).
1 1000 ohm carbon potentiometer.
1 .025 meg carbon potentiometer.
1 2 pole 5 position rotary switch.
1 1 pole 12 position rotary switch.
1 Centre tapped audio choke.
3 RF chokes (RCS type RF86 or RF81).

RESISTORS

2 .25 meg ½ watt.
1 .1 meg ½ watt.
1 .02 meg ½ watt.
2 500 ohm carbon.
1 5000 ohm 5 watt WW.
1 300 ohm ½ watt.
1 150 ohm ½ watt.
1 100 ohm carbon.
1 10 ohm carbon.

CAPACITORS

2 8 mfd 525v electrolytics.
3 .01 mfd 400v paper.
2 .01 mfd mica.
1 .002 mfd.
2 .001 mfd.
1 100pf.
1 50 pf.

SUNDRIES

5 3-30 pf trimmer capacitors.
1 large knob, scrap celluloid, 4 pointer knobs, 2 2-circuit shielded sockets and 1 plug to match, tag strips, length of shielded cable, crocodile clips, hook-up wire, tinned copper wire, spaghetti, short lengths of 19 and 24 B & S enam. wire, ¼in diam. paper tubing, ¼in diam. fibre rod, solder lugs, 2 7-pin minature valve sockets, 1 9-pin minature valve socket, rubber grommets, scrap aluminium, power flex, power plugs, nuts & bolts, etc.

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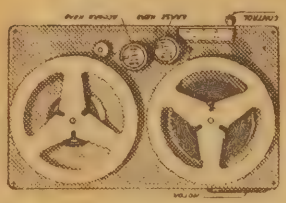

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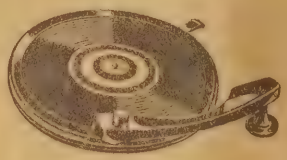

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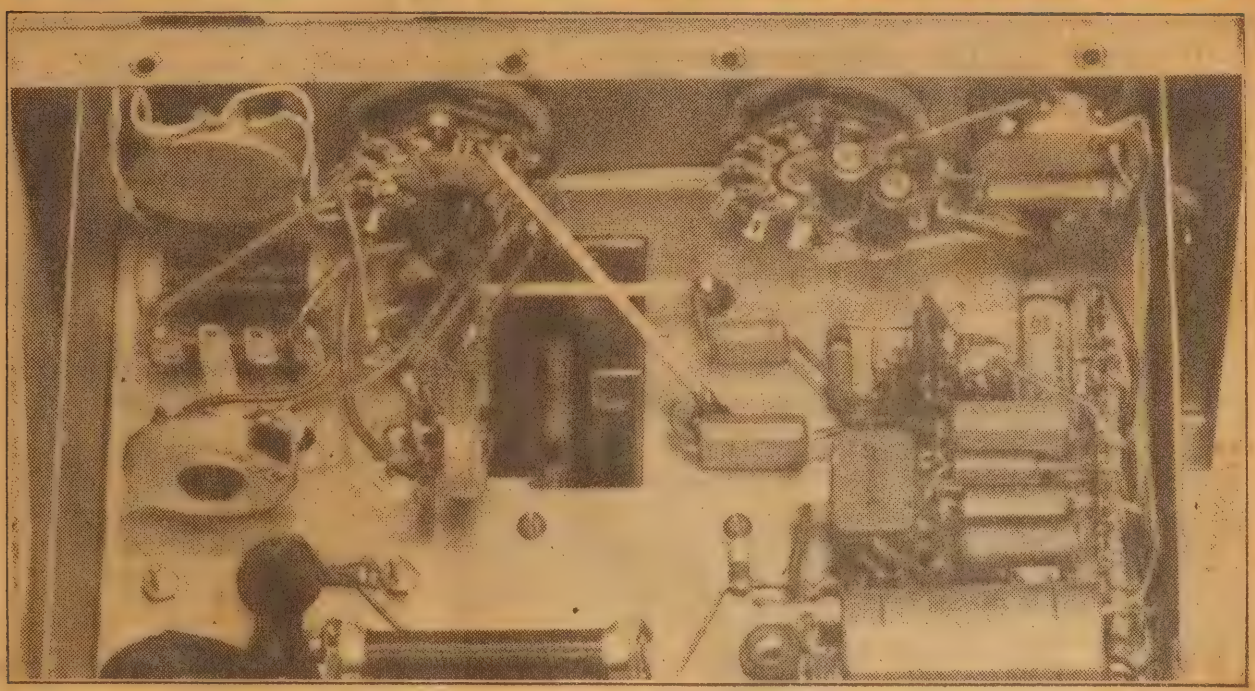
UNDER CHASSIS VIEW SHOWING OSCILLATOR COILS



With the shields removed, the coils can be seen to the left and the attenuator to the right. The coil for the highest frequency band is soldered directly across the switch. The remainder are mounted on tag strips.

nals from radio stations. This requirement is not difficult to satisfy. Any well designed oscillator with all components mounted firmly in place will hold its calibration sufficiently well to enable ordinary broadcast and short-wave receivers to be calibrated as accurately as their own design will allow.

However, no modulated oscillator of simple design can do the job of a frequency meter. If you go in for calibrating bandspread short-wave receivers you will probably need a frequency meter as well. Even costly signal generators are not accurate enough to take the place of a frequency meter.

So much for a general discussion of signal generators and oscillators. Our new instrument does not pretend to be a signal generator but it will do everything that you are likely to require if you are a radio serviceman or build receivers at home.

MECHANICAL DETAILS

One of our standard small instrument cases is used to house the new oscillator. The cases, with blank panels and chassis, are standard items with radio supply stores these days. A blueprint giving the exact position of all holes will be prepared and passed on to the chassis manufacturers so that you will be able to buy a chassis with all holes punched at a slight extra cost.

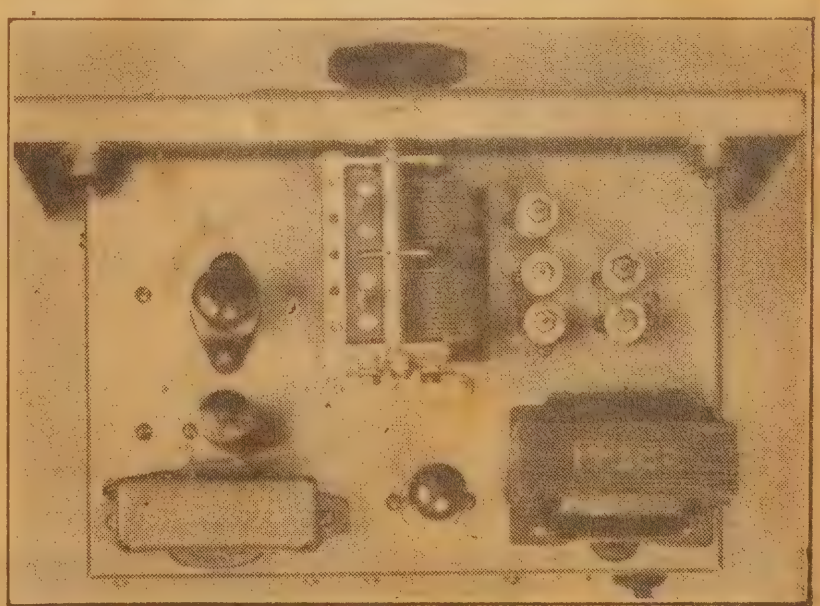
The layout of the other parts is set by the tuning capacitor which is mounted in the centre and in such a way that the control shaft is as low as possible. The purpose is to provide a favorable position for the tuning scale.

The rotor plates come below the level of the chassis making it necessary to cut a rectangular hole. It will be necessary to slightly modify the mounting brackets supplied by the manufacturer but this should not cause any difficulty.

The 12AU7 valve which contains both the RF and audio oscillator elements is mounted in a position alongside the capacitor which allows short connections. The positions of the amplifier valve and centre tapped choke are not particularly critical and it is convenient to put them behind the 12AU7.

The other controls are grouped symmetrically along the bottom of the front panel. The bandswitch, below and to the left of the tuning knob, allows short leads between the tuning capacitor and the coils which are mounted under the chassis. The modulation control is remote from the circuits it controls, but this is not important.

Two attenuator controls mounted at the bottom right hand corner of the panel complete the symmetry. Above them is the RF output socket. This, in turn, is balanced by the AF output socket to the left.



Layouts of components above the chassis. Note particularly the trimmers in the top right hand corner. One terminal is soldered to the chassis and the other connected to its particular coil by a wire through a hole in the chassis.

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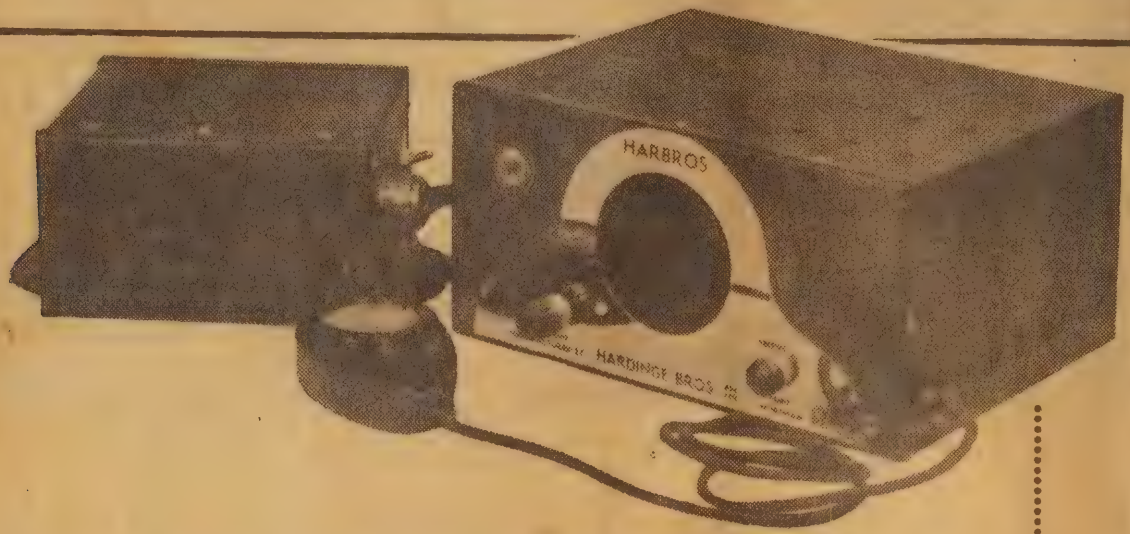

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The space on the chassis above the coils is occupied by a set of trimmers used to trim the high frequency ends of the bands. The remaining space in the rear left hand corner of the chassis is occupied by the power transformer and rectifier valve.

None of the components are crowded and a smaller chassis could probably have been used without too much difficulty. In few cases will there be any point in departing from the standard size.

There are two shields mounted underneath the chassis. One surrounds the attenuator. Its purpose is to prevent direct pickup of the oscillator by the outgoing leads. It is particularly important that direct pickup not occur if the attenuator is to be effective.

The other shield covers the tuning coils and its purpose is to prevent a change in calibration which would otherwise occur when the instrument is removed from its case. Without the shield, it would be necessary to place the instrument back in its case to observe the effect of an adjustment of the trimming capacitors.

OSCILLATOR CIRCUIT

The electrical circuit of the 12AU7 is similar to that of other oscillators we have used in the past. The Colpitts arrangement was chosen because it makes it much easier to provide a set of tuning coils. Only a single coil is required for each band and the coil does not require a tap.

Trimmer capacitors are placed between the grid end of the coil and earth. Their main purpose is to enable the instrument to be recalibrated at a later date should the valve be changed or other components be replaced.

The radio frequency output from the valve is taken from the grid via a small fixed capacitor and applied to the inner grid of the 6BE6.

The remaining half of the 12AU7 operates as a Hartley audio oscillator. Unfortunately it is difficult to make a Colpitts oscillator function at audio frequencies so that a centre tapped iron cored choke is required.

A centre tapped speaker transformer can be used. The exact specifications are not particularly critical and the secondary winding is not required.

AUDIO CHOKE

The characteristics of the choke will affect the frequency at which the oscillator operates. It is desirable that it be about 400 cps and it may be necessary to vary the value of the capacitor connected across the choke in order to achieve this. In our case, the correct capacitor is .01 mfd.

The audio voltage required at the grid of the 6BE6 is relatively small and can conveniently be obtained by placing a small value potentiometer in series with the grid leak of the audio oscillator and connecting the moving arm of the potentiometer to the grid. Any change in the DC bias applied to the grid of the 6BE6 brought about by this connection is sufficiently small to be neglected.

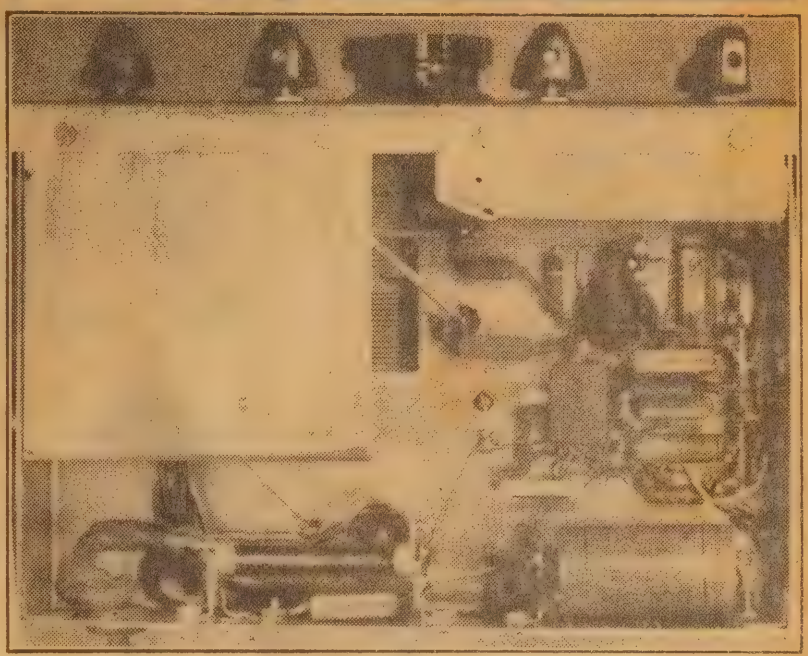
In its simplest form, the waveform of the audio oscillator is usually very poor. In other words it contains a large percentage of harmonics which tend to make the RF signal cover a wider range of frequencies than necessary. The situation can be improved by inserting an unbypassed resistor in the cathode lead of the valve. In this case, 5000 ohms appears to be a good choice.

The operation of the 6BE6 has already been mentioned and requires little further comment. The maximum screen voltage which can be applied is 100 volts. The high tension supply for all sections of the instrument is made 100 volts in order to avoid an extra dropping resistor and bypass capacitor.

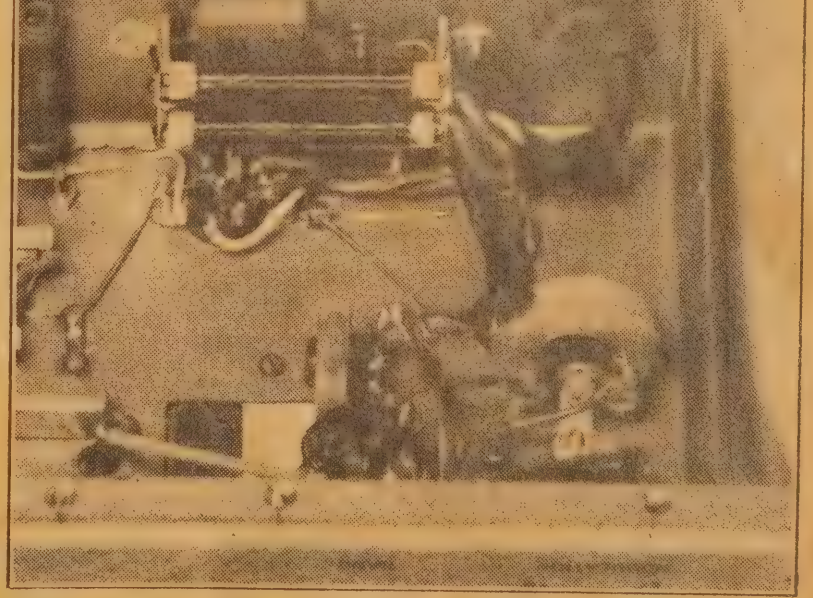
One advantage of the low voltage is that the amount of power developed by the RF oscillator is low. This in turn makes it less difficult to make an effective attenuator.

The 300 ohm plate load resistor for the 6BE6 may conveniently be a ½ watt carbon or wire wound type. If the latter, the amount of inductance should be sufficiently low not

SHIELDING UNDER THE CHASSIS



The large shield at the left covers the coils so that the alignment of the instrument is not affected by removal from the case. The shield at the right covers the attenuator. Along the bottom, the electrolytic capacitors are to the right and the mains filter chokes to the left.



The mains filter chokes are mounted between two tag strips bolted on the rear of the chassis. A mica bypass capacitor goes from the transformer end of the choke to ground in each case.

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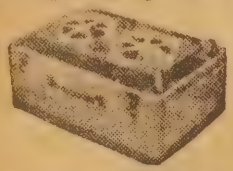

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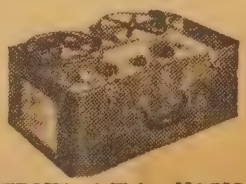

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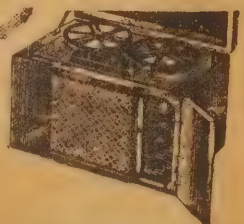

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to cause resonances within the range of the oscillator. Most of the standard resistors now available will be satisfactory.

In the case of the resistors in the attenuator, it is desirable that they have as little inductance as possible. For the various resistances, including the attenuation potentiometer, we suggest you obtain carbon types.

Earth returns inside the attenuator should be made to a single point. This can conveniently be the cover of the potentiometer. The outside braid of the output cable should be returned to this same point.

Two connections are provided by the outlet socket. One is used for the centre conductor of the shielded cable and the other for the outside braid. This is done so that the outside braid of the cable need not make contact with the panel.

FOR AUDIO TESTS

A similar outlet socket is provided for the audio so that the same outlet cable can be used for audio testing. Plenty of audio output is available for routine testing of the audio amplifiers of receivers. It is controlled by the potentiometer used to control the modulation depth.

One source of RF leakage is the power cable supplying AC to the transformer primary. An expensive signal generator would include fairly elaborate precautions in order to keep this down to a very low level, but in a simple instrument such as ours, a pair of hand-wound RF chokes plus a pair of bypass capacitors do an adequate job. Use mica capacitors if possible as they are less likely to break down than paper types.

To cover the entire range between 150Kc and 30 Mc with the available tuning capacitor, at least 5 coils are required. With the Colpitts circuit only a single untapped inductor is required for each range which greatly simplifies the job.

We found that the RCS RF86 or RF81 choke used as a tuning coil covers the range between 150 and 550 Kc. By removing 100 turns from another RF86 choke we were able to make the oscillator cover from 550 Kc up to 2.0 Mc. The next range, from 1.8 Mc to 6.5 Mc, is covered by another RF86 choke, this time with 200 turns removed.

THE COILS

Frequencies between 5.5 Mc and 20 Mc are covered by a coil consisting of 27 turns of 19 B & S wire close wound on a ½in diameter bakelised paper former. Finally, a self supporting coil consisting of 4 turns of 19 B and S wire ½in diameter and ¼in long is wired directly across the appropriate terminals of the bandswitch. It covers between 15 Mc and about 50 Mc. If you use a valve other than the 12AU7 there is a possibility that you will have difficulty in getting the oscillator to operate reliably as high as 50 Mc. In this case you may be satisfied to limit the coverage to, say, 30 Mc.

You are not likely to have a great deal of use for frequencies above 30 Mc so that there is little point in making a special effort to achieve an extended range.

You will note from the above paragraphs that the frequency coverage for each band is very wide considering that the maximum effective capacitance across the tuned circuit is only 225 pf. (The two sections of the tuning gang are actually in series across the coil.) This is accounted for by the very low minimum capacitance which is a feature of the Colpitts circuit since stray capacitances from the grid side of the circuit to earth and the plate side of the circuit to earth are in series.

In our case it was convenient to mount the coils on tag strips which were bolted to the chassis. If you can think up a better scheme, by all means go ahead and use it. It is not a good idea to mount the coils too close to each other because of the possibility of idle coils absorbing energy from the operative coil. In extreme cases the oscillator would stop operating altogether.

You will see from the underneath photograph that we have attempted to arrange the coils so that coupling is at a minimum.

As a first check we would suggest that you remove a few turns less than we have specified from the RF chokes. If then the inductance proves to be too great, more turns can be removed.

If you do not have RF chokes of the type mentioned, a winding taken from an old 175 Kc IF transformer should come fairly close to the required value of inductance. The parallel capacitor should be removed, of course.

ALTERNATIVES

Similarly, a winding from a 455 Kc IF transformer should come fairly close to providing the correct inductance for the next higher range.

The grid winding from a pie wound broadcast coil, either aerial or RF, should tune low enough to overlap the previous range and up to about 2.0 Mc at the high end of the range.

Two hand wound coils would then be required to complete the range up to 30 Mc. For a service oscillator described in a previous issue of Radio and Hobbies the larger of these had 37 turns of 28 B and S wire close-wound on a ½in diam. former and the smaller 12 turns of 28 B and S wire spaced to occupy ¾in on a ½in former. There is no reason why the data should not serve equally well for the new oscillator.

In any case, we will have more to say on the subject of coils in an article on calibrating the instrument which is to appear in the February issue. These two subjects go hand in hand.

CALIBRATION

In the meantime, a few remarks on calibration may be of assistance to those who complete their instrument before the next article becomes available.

If you can borrow a frequency meter for an evening, it is simply a matter of connecting the output of the oscillator to the appropriate terminal of the frequency meter. The correct indication is usually obtained by adjusting the oscillator to "zero beat" with the frequency meter or vice-versa.

Most frequency meters will respond equally well when the oscillator output is a multiple or submultiple of the frequency meter dial reading. However, this should not cause undue difficulty since you will have some idea of the frequency from the coil in use and the setting of the tuning capacitor.

You may need to make use of this phenomenon to calibrate the oscillator over extremes of the range not covered by the frequency meter. For example, if the meter covers only down to 300 Kc, you can calibrate the 150 Kc position by beating the second harmonic of the oscillator with the frequency meter. The reverse procedure may be needed to calibrate the high end of the range.

Another service oscillator, the calibration of which is known to be accurate can be used as a frequency meter. In this case, you will need to connect the output of both instruments to a receiver so that the beat frequency can be heard. Use can be made of harmonics as before.

Incidentally, you can check the operation of the oscillator by connecting a milliameter between the end of the .1 meg grid return resistor and earth. The current should be about .1 milliamp over most of the range, but at the low frequency end of the highest range it may be as low as .02 milliamp even at this low value there should be no doubt about the reliability of oscillation. Note that the positive terminal of the meter goes to earth.

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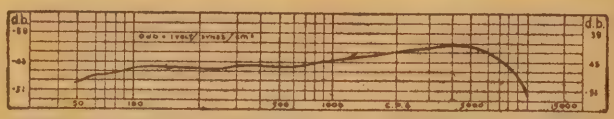

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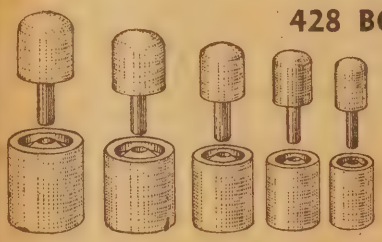

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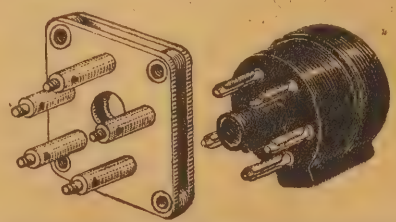

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AIDS TO INDUSTRIAL ELECTRONICS

Many tubes distinctly different from conventional vacuum tubes have been designed specifically to meet the rigorous demands of industry. In general, these special types may be considered to take up where the better-known high-vacuum tubes leave off.

PART 3

THEIR design and characteristics, as well as the manner in which they operate, differ so markedly from comparable features of the high-vacuum tube that an understanding of industrial tube operation is prerequisite to a study of the machinery and devices in which they are employed.

Essentially, most industrial tubes are controlled, high-current rectifiers. This is as might be expected since a large number of industrial demands are for electronic equipment that will switch high levels of electric power.

These tubes have been provided with great sensitivity to meet another industrial demand—a minimum of apparatus.

Although some large vacuum tubes are used in industry, their capabilities per unit of cost do not begin to equal those of other special tubes.

Industrial tubes differ constitutionally from the familiar high-vacuum tube mainly in the introduction into the former of certain inert gases or mercury vapor. This is in order that the useful phenomena of ionization may be made available.

HIGH EFFICIENCY

Electrically, they provide higher efficiency than do vacuum tubes, increased power-handling ability, reduced power loss, and lower voltage drop. In many cases, tremendous power amplification is indicated by the ratio of controlling power to controlled power.

In industrial tubes, ionization of gas or mercury vapor is enlisted to obtain the high anode (plate) currents commonly associated with these tubes. Their peculiar features of operation are due directly to employment of the ionization principle.

An interesting point is that industrial tubes may have hot or cold cathodes, depending upon the type of tube and the purposes for which it is intended. Several cold-cathode tubes have been developed. Dispensing with the heated filament is a useful expedient in cases where economy of installation, operation, and maintenance is an essential factor.

SPECIAL TYPES

Noteworthy among these special type tubes are gaseous triodes and tetrodes, grid-glow tubes, thyratrons, ignitrons, and externally-controlled rectifiers such as the magnetron and permatron. Several of the important types will be discussed in this article, using in some cases, names made familiar or even introduced by individual valve makers. Limited space does not permit a description of each of the numerous tubes having useful industrial characteristics, so we have selected widely-used representatives of each class.

The gas-filled triode or tetrode, unlike its high-vacuum counterpart, is not primarily an amplifer. In its applications, the switching of current is of much more importance than amplification. Actually the power controlled in the switching operation is usually hundreds of times larger than the power that controls the tube, and this might be regarded as a form of amplification.

The distinguishing electrical behavior of the industrial tube is due to the uncommon action of its grid electrode.

GRID FUNCTION

The grid in a gaseous tube serves only to start and stop the flow of plate current, exerting no modulating effect upon this current once it has begun to flow. As a result, the plate current is either at its maximum value or at zero. Thus, the gaseous tube answers every description of a one-way current valve.

In a high-vacuum tube, plate current is reduced very nearly to zero by some value of negative grid voltage. If the grid voltage is then made less negative than this value, more plate current will flow in accordance with the Eg-Ip characteristic of the tube.

Futher variation of the magnitude or polarity of the grid voltage produces corresponding plate current variations.

In a gaseous tube, on the contrary, the plate current rises very sharply to its maximum value (for the applied plate voltage) at the instant that the grid voltage is made less negative than the cut-off value for that plate voltage.

This rise may be delayed or graduated only by circuit conditions, not by grid voltage changes.

SHEATH OF IONS

This peculiar action of the gaseous tube grid is attributed to a thin sheath of positive ions which forms around the grid structure as soon as ionization of the gas takes place and shields the grid electrostatically from the other tube elements.

The plate current of a gaseous triode may be in the hundreds of amperes, compared with the vacuum triode plate current which rarely exceeds several hundred milliamperes. The current-handling capability of the gas triode is therefore many times greater than the maximum values normally afforded by high-vacuum tubes.

Each value of plate voltage has a corresponding value of grid voltage which will prevent the discharge within the gaseous tube from taking place. A more negative value of grid voltage has no effect whatever, but a less negative value will allow the discharge to obtain. Once the discharge has been initiated, however, the grid loses control, as explained earlier, and no variation of the grid voltage amplitude will then alter the value of plate current or stop its flow. Only by removing the plate voltage long enough for deionization to occur may the plate current he interrupted and control be restored to the gird.

A definite time interval elapses between the instant of removal of the plate voltage and complete deionization. This deionization time, due to the fact that the ions and electrons do not disappear immediately from the active space, may be as great as several micro-seconds.

The grid regains control only at the end of this deionization interval.

Similarly, the gaseous tube does not "fire" immediately when the anode voltage is applied, but a few microseconds later. This interval is termed the ionisation time.

Industrial tubes used in certain circuits, such as inverters, must possess a short deionisation time. In other applications, longer deionisation times can be tolerated.

NEGATIVE CONTROL

There are both positive-controlled and negative-controlled gaseous tubes. However, the latter type is most widely used at present.

High currents flow in gaseous tubes with low voltage drop. Hence, larger plate currents are obtained with lower plate voltages, a feat not possible with costly high-vacuum tubes. The greater current and power flow is due to the increased electron density provided by ionisation. Plate power loss is very low.

In controlled-rectifier circuits employing tubes, it is possible to effect grid control of the unidirectional anode current flow either by means of a direct or an alternating grid voltage. In the latter case, the phase of the grid voltage may be so regulated with respect to the anode voltage phase that any desired portion of the positive half-cycle of the latter may be rectified.

THE THYRATRON

The thyratron is a hot-cathode, grid-regulated, heavy-current triode or tetrode. Like other industrial tubes, its internal power loss is very low compared to the high-vacuum tube, a feature which makes it ideal for the handling of large currents, and its cathode is designed for the emission of electrons in profuse numbers.

Depending upon type, the thyratron may be either gas-filled or it may contain a small amount of mercury to be vaporised during operation. Ionisation of the gas neutralises the spacecharge electrons, thereby, providing through the tube a constant voltage drop of low magnitude.

Once the thyratron plate current has been started, its actual value cannot ordinarily be altered by changes in the grid voltage. The con-

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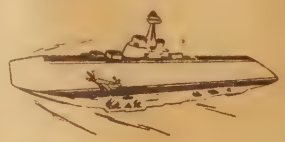

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trol element in the thyratron, as in other gaseous tubes, does not permit a continuous control of plate current but se ves solely as a trigger fo initiatin current flow.

For any value of thyratron plate voltage, here is a distinct value of direct grid voltage (the ignition point) at which ionisation just occurs and plate current flow is started. From this point on, the effect of the grid voltage is negligible, the grid regaining control only when the tube discharge is extinguished long enough for deionisation to take place.

There is no initial flow of electrons when the grid is more highly negative than the ignition point.

Thus, the important thyratron characteristic curve does not depict the relationship between grid voltage and plate current, as is customary with high-vacuum tubes, but rather the Eg-Ep combination at which plate current flow is just initiated.

GRID RESTORATION

Thyratron grid control is restored also when the plate voltage falls to a very low value approaching zero when Ep is less than the voltage required to maintain the arc; it is assumed that the time interval is sufficient for deionisation to take place.

Thus, if the thyratron anode is supplied with alternating voltage, control is restored twice during each cycle. The grid may then postpone the tube discharge to a point on the positive half-cycle corresponding to the extent to which the grid voltage is more negative. Operation of the tube may therefore be conveniently obtained over any predetermined portion of the alternating plate- voltage cycle.

This feature is utilised in several industrial applications, as will be shown later.

Among its many important industrial applications, the thyratron finds employment as a heavy-current rectifier in which off-on action is obtained either by adjustment of the amplitude or phase of the grid voltage, in DC-to-AC inverters, and in trigger-type high-current control devices.

GRID-GLOW TUBES

The grid-glow tube is an interesting gaseous controlled-rectifier tube of the cold-cathode type. By dispensing with the filament-heating equipment necessary to most tubes, greater economies in auxiliary equipment and power consumption are effected.

In the grid-glow tube, the gas discharge is initiated directly by the tube potentials. The positively charged anode attracts electrons from the cold cathode region with sufficient velocity to ionize the gas and produce the additional electrons required to carry the normal tube current.

When the grid voltage is positive in a grid-glow tube, the voltage between the grid and cathode is the sum of the anode and grid voltages. At a certain value of this sum (when the positive grid voltage has exceeded its critical value), a grid-cathode discharge through the gas is initiated, and shortly thereafter this discharge transfers to the anode, forming the main discharge of the tube.

Thus, conduction in a grid-glow tube is established automatically by two steps in quick succession.

The length of the time interval between the initiation of the grid-cathode discharge and the formation of the main discharge depends largely upon the value of plate voltage. The voltage between the plate and grid electrodes must always be sufficiently high to transfer the discharge.

A particular advantage of the grid-glow tube is that it may be controlled by a low-voltage high-impedance source such as a photocell, by low values of current, and by the discharge of small condensers.

FOUR ELEMENT TUBES

Several advantages are claimed for tetrode versions of the high- current grid-controlled rectifier tube. In general, these follow the advantages of tetrode and pentode vacuum tubes over the simpler triode type. For example, the gaseous tetrode, draws less grid current than the triode, thereby presenting a higher impedance to the source of control voltage.

A particular feature of the shield-grid control tube is that the point at which the discharge is initiated in the gas may be varied by means of the screen voltage and may be made either positive or negative thereby.

A fluctuating screen voltage will impart to the tube a control characteristic of reversing polarity, being successively positive and negative over various portions of the AC anode-voltage cycle.

This feature enables interesting phase-controlled circuit arrangements.

POOL TYPE CATHODES

Use has been made extensively of the mercury pool as a cold-cathode emitter of electrons. A typical example is the mercury-arc rectifier which is to be found in numerous stationary high-power installations. The mercury pool emits electrons in huge quantities in a rectifier tube and makes a surprisingly rugged cathode.

Special advantages of the pool-type cathode are that it requires no heating, is capable of heavy emission, will withstand severe instantaneous overloads, and possesses long life.

In the mercury-arc rectifier, the initial electrons which move to the anode during positive half-cycles of anode voltage are supplied by a "keep-alive" circuit consisting of a small arc maintained between a special keep-alive electrode and the cathode pool surface.

When the arc "strikes" between the anode and the pool, a cathode spot is formed on the surface of the mercury and this becomes a far better source of electrons than common filaments and hot cathodes.

Such a rectifier has a very low voltage drop and may be employed to handle thousands of amperes, the main disadvantage of the light-duty types being the wasteful keep-alive circuit they require.

THE IGNITRON

The ignitron is an improvement upon the mercury-arc rectifier just described. This tube, while retaining the desirable characteristics of the arc rectifier (e.g. the cold, pool-type cathode, high current capacity, and long life), dispenses with the undesirable keep-alive circuit.

In the ignitron, the cathode spot is formed initially by a spark passed between a suitable substance, such as a carborundum crystal, and the cathode pool into which it is immersed.

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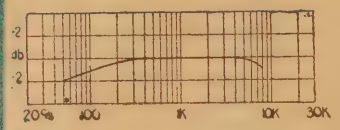

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OP-1A	10	5000, 2500 SE	500
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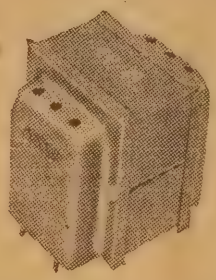
OP-3	15	6600 PP	12.5, 8, 2.3
OP-4	15	10000 PP	12.5, 8, 2.3
OP-11	25	6600 PP	500, 250, 125
OP-12	25	10000 PP	500, 250, 125
OP-15	32	6600 PP	500, 250, 125
OP-16	32	10000 PP	500, 250, 125
OP-37	80	6400 PP	500, 250, 125



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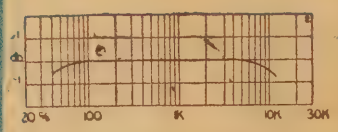

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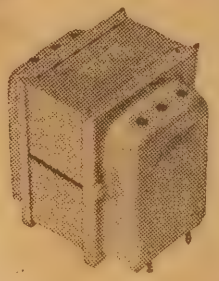

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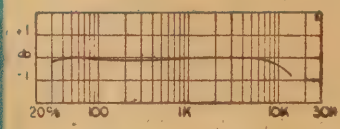
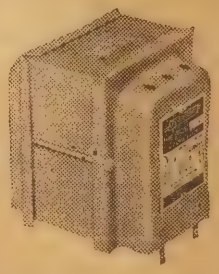
These transformers are primarily for use with Goodman and other extended frequency response speakers. Section below is only small part of our range.

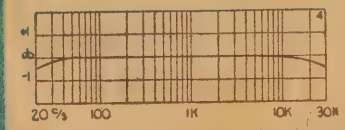


Code No.	Watts	PRIM. Z.	SEC. Z.
OP-22	10	3250 SE	500, 25, 2.3
OP-23	10	3250 SE	12.5, 8, 4, 2.1
OP-19A	15	5000 PP	12.5, 8, 2.3
OP-19B	15	5000 PP	500, 250, 125
OP-21	15	8000 PP	500, 250, 125
OP-62	15	10000 PP	500, 125
OP-63	15	10000 PP	15, 3.75
OP-64	15	10000 PP	12.5, 3.125
OP-65	15	10000 PP	8.4, 2.1
OP-51	20	4500 PP	15.5, 12.5, 8.6, 2.8, 2

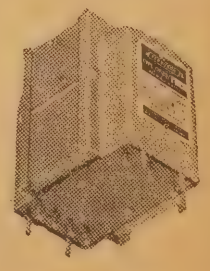


SPECIAL HI-FI RANGE
20-30000 C/S ± 0.5 dB

These transformers are for use in the Williamson Amplifier, and fulfil every requirement specified by D. N. T. Williamson.



Code No.	Watts	PRIM. Z.	SEC. Z.
OP25/500	15	10000 PP	500, 125
OP25/250	15	10000 PP	250, 62.5
OP25/40	15	10000 PP	40, 10
OP25/16	15	10000 PP	16, 4
OP25/15	15	10000 PP	15, 3.75
OP25/12	15	10000 PP	12, 3
OP25/10	15	10000 PP	10, 2.5
OP25/8.4	15	10000 PP	8.4, 2.1
OP-66	15	5000 PP	8.4, 3.7
OP-67	15	5000 PP	15, 6.5



Ferguson Transformers Pty. Ltd., Ferguson Lane, Chatswood—Phone JA2878. Available from retailers in every State.

The discharge then shifts quickly to the nearby positively-charged anode within a few microseconds.

The ignitron electrode consumes little current compared to the keep-alive electrode of the conventional mercury-arc rectifier which must be kept supplied to maintain the arc

The ignitron provdes a controlled rectifier of the pool type which may be put into service instantly. No prolonged warm-up periods are required by this device.

EXTERNAL CONTROL

Up to this point, only tubes with internal control electrodes have been scribed. However, the contro current flow through high-level rectifiers is not entirely a property of the conventional grid alone.

It is a matter of record that common mercury-vapor rectifier tubes of the heated filament type have been controlled by means of grids wound around the outside of their bulbs.

Such simple successes have led to refinements of the external control electrode, and these introduce a still different class of high-current control tubes.

Although certain disadvantages of externally-controlled tubes may be at once apparent, distinct advantages of the external electrode are its isolation (in some circuits) from the discharge path and the possibility of insulatng it from the other elements.

Also, it may be readily applied experimentally to certain of the diode type rectifiers.

Both electrostatic and electromagnetic control have been accomplished externally.

Electrostatic control is enabled by an external control grid which sets up an electrostatic field within the tube. Electromagnetic control is based upon the ability of a magnetic field passed through the anode-cathode interval to operate upon the discharge in the same manner as a negative grid voltage.

KATHETRONS & MAGNETRON

The kathetron is a special tube utilitising electrostatic control. The control-grid electrode, taking the form of a wire coil or mesh, is wound around the outside of the envelope and sets up a useful field inside the tube by a two-step chain of events: the external charge induces charges on the inside wall of the tube envelope, and these in turn set up the internal field.

The magnetron is a high-vacuum rectifier tube in which plate current flow is controlled by an external magnet winding.

Operation of the magnetron, and other magnetically-controlled rectifiers, depends upon the ability of a magnetic field to deflect electrons in motion out of their normal cathode-anode path. Electrons moving toward the positively-charged anode are accelerated or retarded according to the strength of the magnetic field set up inside the tube by the external coil.

THE PERMATRON

Actually, their paths are bent by the field, and if the resulting curvature is great enough, they will not reach the anode at all and no current will flow.

Like the magnetron, the permatron makes use of an external magnet coil. The permatron is functionally

(Continued on Page 111)

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Let's Buy An Argument

There's an old but evergreen joke to the effect that "Not all radiomen are mad but (with comic agitation) it helps a lot if they are." While I normally deplore such libel, any convictions I may have had on the point received a shaking just recently.

by W. N. Williams

FROM a reader at Rainworth, Qld., I received the blueprint of his "30-valve Universal Radio Receiver, Mark V." In his own words . . . "It is forwarded as an item of academic interest, indicating what happens when one goes too far in developing a radio receiver."

I can only resort to the vernacular with the retort, "You're telling me."

In fact, I would like nothing better than to reproduce the design as a diversion for circuit-happy types.

A CIRCUIT MAZE

After all, if schoolboys and tired businessmen can spend time finding their way out of a printed maze, I guess that tired radiomen are justified in doing likewise with an electronic equivalent.

Unfortunately, nothing less than a yard-long blueprint is adequate to contain it.

However, by the explanations on top of the print, I gather that the receiver is divided into five main sections.

The first section, containing about 19 valves in all, is a 5-band double-change superhet, switchable to a TRF circuit for wide-range listening. There looked to be a special set of valves for the highest frequency range, plus sundry other stages and "things".

Section 2 is yet another tuner—a relay-controlled push-button affair for local listening.

Section 3, labelled "upstairs", involves all the cabling, the contacts and doovers necessary to control this tuner remotely, plus speakers and independent volume controls.

Then comes the amplifier section—10-watt 6V6's—and finally the voltage compensated power supply. In all, 30 valves and 25 controls, not including the push buttons!

Can you imagine the reaction of some poor unsuspecting serviceman, called in to service the equipment because "it won't go". It makes a technical editor's job look pretty easy by comparison.

But, believe me, B.B., I know how it is. You start off by building up something that is a little more clever and complex than average—just enough to make you feel proud of it!

Then you realise that, by adding this and that, you can make it do something else. After several such additions, none of them very complicated in themselves, you suddenly wake up to the fact that you've created a monster that only you can understand.

UNIT CONSTRUCTION

You are haunted by the fear that it will keep going just long enough for you to forget what it's all about. Then you'll suddenly have to fix it!

The point behind all this is one that I think I've made before. After reaching a certain degree of complexity with these "Universal" or centralised radio systems, it becomes more logical and certainly simpler to break them up into their parts and functions and present them to a wondering world merely as a number of separate sets.

So, if you want to listen to a program upstairs, it isn't really a bad idea to provide a separate installation. At least you don't have to listen to the program the maid wants, or vice-versa.

And again, if your interest in 30 megacycle listening is enough to warrant extraordinary circuit provisions, then a separate receiver will allow you to listen to your precious high frequencies while everyone else is absorbed in the this-and-that show.

REACTIVATION

By way of variation, the same correspondent says about reactivation of dry batteries:

"*. . . It all agrees satisfactorily with a few fairly futile experiments I carried out several years ago.*

"*The main point seemed to be that the nuisance value of mucking around with cells far exceeded the purchase price of new ones; also that reactivated cells were unreliable and, in fact, usually almost dangerously over-voltage.*"

The nuisance aspect of reactivation has already been discussed as also the question of over-voltage.

As far as we can see at present, the danger of over-voltage is actual-

ly not very great, provided the charge rate is kept down to about one-third of the discharge rate, and that due note is taken of the load and charge periods.

The question of "unreliability" may have a lot more angles than appears on the surface.

In the first place, as we have already pointed out, battery manufacturers do not treat reactivation as a prime consideration when designing batteries or considering service life. Their chief aim is to get the best overall results from the battery in ordinary service. If the user chooses to charge them, that is entirely his affair. It has no place in any maker's guarantee.

Then, again, batteries can be designed to give high initial output for a short period, moderate output for a longer period or they may be designed to give the maximum possible shelf life. This must have some bearing on tolerance to reactivation.

BATTERY LIFE

The policy of different manufacturers will vary in this regard, and, in any case, there will be a difference between batteries intended for different applications. Observations made on a torch cell won't necessarily hold for a miniature radio battery and so on.

Then, too, it is hard to fix or limit figures, which allow one to say that a battery is too high in voltage or worn-out.

There's a perpetual argument on this score the world over between valve and battery manufacturers, as to what constitutes an acceptable range of filament voltage.

The battery manufacturers would naturally like to see filaments that emit and valves that perform just as happily on 0.8 volt as they do on 1.6.

To valve manufacturers it's a near-impossible problem. Their reaction is more along the lines of "We only make the filaments. It's your job to provide the volts!"

All of which is, of course, somewhat by the wayside. But it is farther reason why you can't answer a question about reactivation with a simple yes or no.

A POSER

Now for an abrupt change in subject matter. When the last issue was in course of preparation, the editor walked into my office and began quoting a passage from the article it contains on grid bias. Something to the effect that a poorly regulated bias source was desirable for linearity in a class C plate-modulated amplifier.

Having quoted the said passage, he took three quick puffs from his pipe, transferred it to one side of his mouth, smirked with the other side and said simply, "Why?"

"Well, it's like this . . . er . . . you see . . . er . . ."

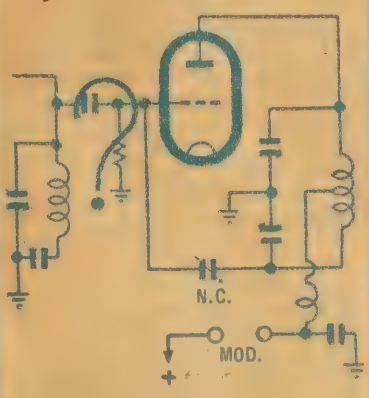
If only the phone would ring and give me a little bit of stalling time!

It's one of those statements that are made with monotonous regularity and accepted as Bible truth. But you try to find a text-book that explains just why it should be so! That's probably why the explanation didn't jump to my mind either.

Let me repeat the alleged truism: **". . . the poor grid-bias voltage regulation desired for linearity in class C radiotelephony may be obtained easily with a grid leak, since bias secured by this method changed with modulation in the plate circuit."**

TRANSMITTER BIAS

GRID-LEAK bias or some other form of poorly regulated supply should always be used in the interest of linearity in a class C plate modulated stage



So say the textbooks . . but why? Work it out for yourself, then see if your ideas agree with those suggested in the article. It will be a good exercise for budding hams—and those in full bloom as well!

There are, of course, just about as many variations to this wording as there are text-books.

Such is the assertion, but what is the explanation? As they say in the shoe-shop, "try this one for size".

One of the features which distinguishes a class C amplifier is the provision of an operating bias, which is generally more than twice the value for plate current cut-off. The peak RF grid drive is higher again than this figure, and, therefore, sufficient to swing the grid well into the positive region.

The grid current and the plate current values, as read on a meter, are merely average values of the brief pulses which flow in each circuit at the signal frequency. This much is common knowledge.

CUT-OFF BIAS

Digging just a little deeper, it is necessary to point out that the cut-off bias — and therefore the class C operating bias — is not an absolute value for each particular tube type. Rather does it vary in more or less simple proportion with the applied plate (and screen) voltage.

The higher the plate (and screen) voltage, the greater will be the optimum bias figure and vice versa.

By the same token, the optimum peak RF grid drive is not a fixed value for each tube type. It depends on the operating bias and therefore relates in turn to the plate and screen voltages.

Finally, the grid input impedance of a class C amplifer — the apparent load it presents to the driver — is also a variable quantity depending on the plate and screen potentials.

When the applied voltage is low, a greater proportion of the available emission from the filament flows to the grid. Therefore, the grid input impedance is reduced and it tends to draw more grid current from the driving source.

Conversely, when the plate (and screen) potentials are increased, the grid acts more like an accelerator electrode during its positive excursions. It draws less actual grid current and the valve's apparent input impedance is increased.

CLASS C STAGE

Now let's look again at a class C stage. In the absence of modulation, it has a certain definite plate (and screen) voltage applied. Let's assume that it has a fixed grid bias also, equal to about three times cut-off, and a peak RF grid drive to suit.

Now visualise a sharp increase in plate (and screen) voltage, as would happen under plate modulation. When the voltages finally reach double their original value, what was formerly a bias equal to three times cut-off has deteriorated to only 1½ times cut-off and the operating conditions on the peak of the cycle are more nearly equivalent to class B operation than they are to class C.

The plate current consequently flows over a very large portion of the RF half-cycle rather than over just a small segment. The efficiency of the stage and the essentially linear relationship between plate voltage, plate current, and carrier power is clearly in jeopardy.

To preserve true class C operation during this high voltage peak of the modulation cycle, it is clearly necessary to provide a higher initial bias and therefore a higher peak RF drive. Let's say we do this and observe the consequences.

At the low voltage peak of the modulation cycle, the bias required for three times cut-off, and therefore the peak RF grid drive is quite low—certainly a lot less than we have already provided.

GRID IMPEDANCE

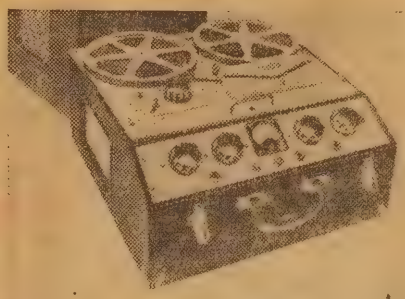
That in itself may not be the most serious factor. What is serious is the fact that the grid input impedance has likewise dropped to a very low figure and the grid current has soared. It may well be that, lacking any form of automatic protection, the grid will draw excessive current and physically damage the valve.

In other words, the bias and drive requirements for a plate modulated amplifier vary so widely between extremes of the modulation cycle that it is well nigh impossible to find FIXED values for both that will maintain satisfactory operation of the modulated stage.

This leads naturally to the idea that at least a proportion of the modulation voltage should be applied to the driver and/or the bias source, so that the grid input will at least bear some relationship to the instantaneous conditions in the plate (and screen) circuits.

This technique is actually follow-

Ferrograph



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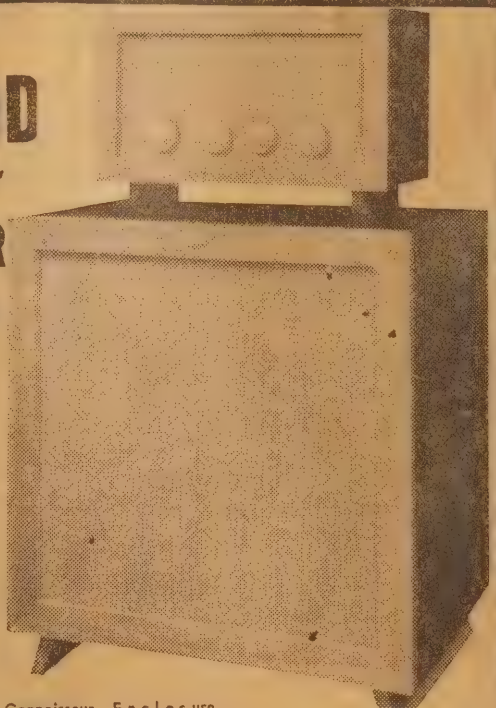

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ed in some cases, though it makes life harder.

Fortunately, however, it is not essential to go to such lengths in simple circuits, because the grid can regulate its own operating conditions fairly well PROVIDED IT IS NOT TIED DOWN TO A FIXED BIAS SOURCE.

To be a little more explicit one might say: Provided the grid can control its own bias.

That is true of only one circuit arrangement — that using grid leak bias alone. Any combination of grid-leak bias with a cathode resistor; a battery or a rectified AC supply for protection purposes, is a step away from the ideal.

EFFECT OF DRIVE

Now let's see what happens.

In the unmodulated condition, the class C amplifier has a certain plate and screen voltage applied and a certain grid input impedance depending largely on that voltage.

RF drive is applied and the grid, acting as a diode of specific impedance, rectifies the positive peaks. It draws current through its return resistor and so charges the grid coupling condenser that the grid acquires a definite measurable bias. Needless to say, the time constant of the coupling condenser and grid leak must be long compared with the duration of the RF input cycle.

The optimum value for the grid resistor, as normally specified by the manufacturers, is related to the valve's own input impedance. It must also be high enough to allow the grid to develop sufficient bias without drawing excessive current.

At the same time, the RF grid drive is specified at the so-called "saturation" level, which is a concise way of saying that there will always be ample drive for proper class C operation, even at the positive peak of the modulation cycle.

That is why grid drive figures for plate modulated class C are normally much higher than for the same valve used purely for CW.

NOT CRITICAL

While this is the general aim, the circuit is delightfully non-critical. If the RF drive happens to be set initially too high, the grid quite automatically biases itself that much higher and the main effect is to shorten slightly the plate current pulse on each RF cycle.

There is some latitude also in the other direction.

The vital point is that the valve is operating initially with an abundance of RF grid drive and in no danger of grid heating.

On positive peaks of the modulation cycle the "abundance" of grid bias and RF drive may deteriorate to merely "enough" but that is the important point—it is enough to maintain the operation of the stage as a class C amplifier.

It therefore maintains constant plate efficiency and the essential linearity between plate voltage, plate current and carrier power.

The operation is assisted to some degree also by an increase in grid circuit impedance and therefore a reduction in the loading on the driver stage. Peak RF grid drive therefore tends to increase somewhat, which is all to the good.

AT LAST!—A SATISFIED READER

I HAVE noticed over recent months considerable discussion about "Playmaster" Amplifiers. Let me say now that I am more than satisfied with the "Playmaster Baby" which is my first constructional effort. My hobby has always been the collection of good recorded music and until recently my records were played through a commercial gram.

My interest in radio began when casually reading through the "Learn While You Build" series in a friend's copy of Radio and Hobbies. I then and there became interested in the audio side of this most fascinating of all hobbies and as a result built the "Baby".

She worked but oh, the distortion! I soon realised that the B.S.R. crystal P.U. must be fed into a different load from that used for a magnetic and an immediate improvement was gained. Variation of the feedback resistor to 800 ohms completed the anti-distortion measured and I then discarded my 8K. in favor of a 12.0. I am so pleased with the result I had to make this letter my first job this morning.

As you will realise I am a complete novice and it is only through the simple circuits and clearly explained articles that I was able to achieve the results I did. That is one feature of Radio and Hobbies which I like and I am sure John Moyle is behind it. You are not above helping the novice in every way.

Please tell Neville Williams that I would not have got the results I have unless I had read all of his articles in the "Argument" series on audio together with the other tips which appear from time to time.

I intend delving into the realms of push-pull amplification at a later stage at the moment I am perfectly satisfied with my present job.

Best of luck to Radio and Hobbies and its staff.

Sincerely, R.P. (Brisbane Qld.)

During alternative half-cycle, the plate and screen voltages may be very close to zero and here the true value of the grid leak system is seen.

With the reduction in grid impedance and the abundance of drive, the grid tends to draw heavy current. However, any increase at all in the grid current produces a larger charge across the grid coupling condenser, a large resultant bias and therefore a substanital reduction in the duration of the grid current pulses.

The average grid current will rise during modulation troughs but not enough to damage the valve. What is more, the additional loading on the driver drops the RF drive somewhat, which is all to the good.

That is why the grid current is always higher in a class C stage with no plate voltage applied. It is also the reason why amateurs don't melt grids in grid-leak biased stages when tuning up without plate voltage applied.

If fixed bias were the order of the day, there might be a different story to tell!

And that, I think, just about completes the explanation. To reiterate:

(1) Grid leak bias allows very high RF drive to be applied to the grid initially, affording protection to the grid and also rendering the circuit non-critical.

(2) The high drive and bias thus made possible are adequate to sustain correct operation of the stage, therefore linearity, at peaks of the modulation cycle.

(3) The grid is protected during troughs of modulation because the bias voltage is free to rise.

That, I should imagine, will be enough for transmitting types to think about for the time being.

DIRECT COUPLING

As a parting shot, let me have a few brief words with the "audiophiles." Translated from American into English, the term refers to people interested in audio amplifiers and reproduction therefrom.

Just this: Please retain your sense of balance about cathods followers or we'll have a new cult in our midst.

Remember the "direct coupling" cult, which was so active in the last decade? Its influence still persists.

Only a few days ago, a very good friend walked into the office, circuit in hand, and eyes aglow. With trembling fingers he spread the page before me and pointed to a particular section. Two of the valves were were directly coupled!

Man! What a circuit! What a design! What a lot of well, one can be over-enthusiastic.

But I sense the same kind of reaction to cathode followers, particularly since we have used them in one or two tuners and a control unit.

(Continued on Page 107)

FULL MARKS . . .

Full marks go to a writer in Science Newsletter who used this par to describe the action of transistors.

"THE scientists then found that if they took pure germanium and introduced meticulously measured impurities in a certain way, they upset the metal's orderly atomic pattern and created a restless structure full of submicroscopic holes and homeless, wandering electrons. When a current passed through the metal it touched off a complicated reaction as the holes moved like bubbles in a liquid and the loose electrons rushed to fill the empty space.

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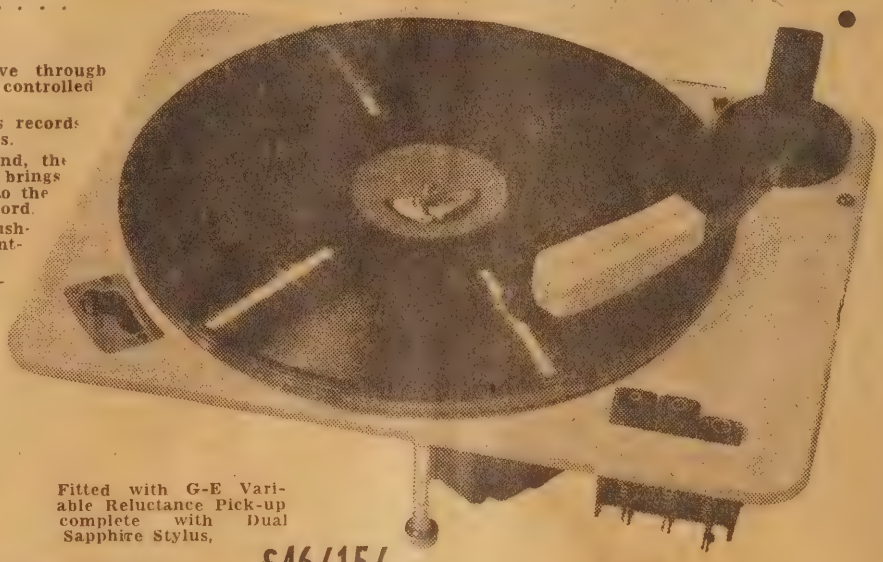

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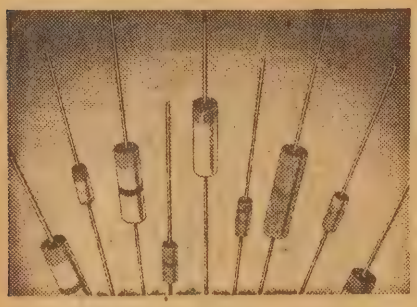

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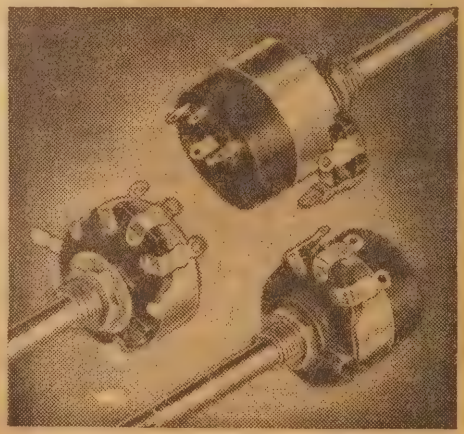

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FROM THE SERVICEMAN WHO TELLS

Every so often someone dumps a set on the serviceman's counter and requests that it be given a complete overhaul. Since this kind of job has its own particular problems I propose to devote a fair amount of space to the subject. I hope it will be of particular benefit to the up and coming serviceman.

THE owner who makes such a request obviously expects that when the job is finished it will be as good as a new set and that the possibility of any kind of failure should have been completely eliminated for the next 12 months.

UNPREDICTABLE STRIFE

One's first reaction to such a suggestion is that it is completely impossible, simply because the more serious failures in a radio set must be classified as unpredictable. That is to say, it is impossible, by any means at present known, to gauge or measure the life expectancy of the great majority of components used in a receiver. Any one of them may test perfectly today and fail completely tomorrow.

However, the owner cannot be expected to appreciate this and the only possible approach is to check as thoroughly as possible all those things which can be checked and put the set in as near new condition as possible. If this is done properly the chances of set failure will be reduced by a very considerable factor and, in many cases, faults can be corrected early in the piece before they can cause serious damage.

Actually, there are a great many things in a set which can be quite effectively checked and the list becomes surprisingly large when one spends a little time to stop and think about it. The fact that some of these may appear to be insignificant in the strictly technical sense can be misleading because, to the owner, a faulty knob is every bit as serious, or even more so, than a faulty dropping resistor causing reduced sensitivity by virtue of a lowered screen voltage. In the one case he can see there is something wrong; in the other he may not even be aware of it.

STANDING TESTS

(Perhaps I should point out that, theoretically at least, all these tests should be made as a matter of course on any set after a major fault has been found and corrected. The fact that this is not always so in practice is generally due to the owners expressed unwillingness to pay for more than is absolutely necessary to make the set work. Thus each normal service job must be treated on its merits.)

Assuming that there are no obvious faults in the set—and this is usually the case — one must adopt a standard routine in order to ensure that nothing is overlooked. Naturally the remarks which are to follow will be of a general nature, intended simply to serve as a guide. In addition to this general routine a serviceman should have his own special list of receivers which need special attention in one respect or another.

About the first thing to be checked is the valves. The normal emission tester is usually quite satisfactory, giving an early indication of end of life phase and also checking for shorts. More subtle defects should show up when checking the general performance of the set and may be most accurately confirmed by substituting a known good valve.

As far as the results of the tester are concerned one may sometimes be a little dubious about replacing a valve which measures "doubtful" but which, by virtue of its type and position in the set, will obviously continue to operate the set perfectly satisfactorily. One feels that there is always the risk that the owner may demand the old valve back (it is good policy to offer it, anyway), plug it into the set, and then chalk up a black mark against your name when there is no obvious difference in the performance of the set.

DOUBTFUL VALVES

On the other hand, it is fairly clear that the valve is on the way out and that it could fail completely in a matter of weeks. This is the very thing which the owner wishes to avoid and the reason he requested that the set be overhauled. The safest procedure in most cases, therefore, is to replace all valves about which there is any doubt and explain to the owner when the valves are returned to him that the ones so marked may have a little life left in them but will not last long.

The importance of the valve test was effectively demonstrated recently when I was asked to check a set which the owner claimed was faulty in the "gram" position. The main complaint was intermittent hum and "a kind of static noise".

The hum turned out to be a faulty earth connection to the pickup cable, which was easily fixed, but the "static noise" was simply straight out gross distortion. It was also evident on radio operation but was less noticeable simply because the users seldom played the radio at anything like the volume they demanded when playing records. The fact that they used the gram for impromptu dances was the main reason for this.

A check with the multimeter showed the immediate cause of the distortion, for the HT was less than 50 volts. This, in turn, was due to a sick 5Y3 and a replacement immediately restored the HT and distortion free performance.

SUDDEN FAILURE

The incident in itself did not impress me particularly until the owner told me that he had had the set overhauled only three weeks previously and that everything had been pronounced OK. Since it is unlikely that a valve had deteriorated from full emission to extremely weak in such a short time it was fairly obvious that this valve—and probably the remainder as well—had not been tested. Had they been, this potential fault would almost certainly have been picked up and the owner saved a second service call.

It is also significant that he chose another serviceman when the set failed so shortly after it had been checked.

Before proceeding to test the set itself it is advisable to check the power cord. In most sets more than a few years old the rubber will be perished and likely to leave bare wire exposed wherever it is moved. Since this presents a very real hazard, both to the owner and yourself, it should be replaced if there is any doubt about its condition.

Now the set should be given a voltage check, covering the HT, and the plate, screen, and bias voltages of all valves. This will help to show up the more obscure valve faults which the tester may have missed, as well as other faulty components such as leaky coupling condensers, resistors becoming unduly high, leaky electrolytic or paper condensers or even dry joints where these may cause wavering voltages.

BATTERY SETS

Such partial failures are not as uncommon as one may imagine and finding them can be a source of considerable satisfaction because it is obviously only a matter of time before they fail completely. In such cases one feels that the routine overhaul is completely justified.

At this point it is necessary to digress and say something about battery sets. Even in the city a serviceman will be called upon to check a fair percentage of portables and, quite naturally, the owner is usually most interested to know the condition of the batteries. It is fairly easy to measure the voltage of the batteries while they are operating the set, this providing an essentially practical load, and from this voltage it is not difficult to judge their condition.

END OF LIFE

Thus a battery which has dropped to 1.1 volts per cell may be regarded as very close to the end of its life, though the exact voltage at which it should be discarded depends to some extent on the equipment. In some cases a figure as low as .8 volt per cell has been quoted while individual cases have been known where sets continued to operate as low as .35 volts per cell on high tension.

So much depends on the design of the equipment, the reception conditions under which it will be used, and the tolerance of the user that it is impossible to lay down hard and fast rules as to when the batteries should be discarded. In some cases you may be able only to advise the owner as to their condition, leaving the final decision to him.

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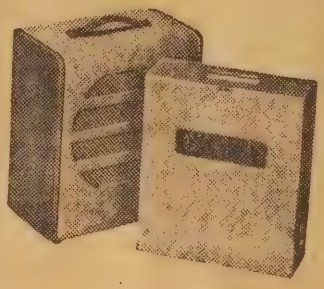

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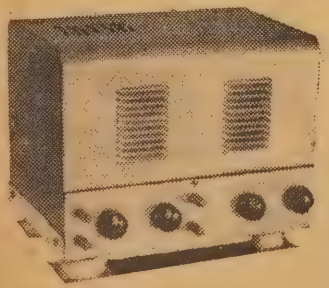

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More usually, however, you will have to use a little initiative and treat each case on its merits. Thus if the owner is not satisfied with the performance and the batteries are approaching their end of life they should obviously be changed. If, on the other hand, the set is still performing reasonably well, even though the batteries are low, it is better to suggest that new batteries be purchased in anticipation of their failure, rather than replace them immediately. In most cases the owner may be trusted to change the batteries himself providing he knows that these were about to fail anyway.

The two important things to avoid are, firstly, the discarding of batteries which still have several hours' satisfactory service left in them (after all, batteries are not cheap) and, secondly, the risk that the set will fail completely just when it is most needed, in any case the owner should always be warned about the damage which can result from leaving discharged batteries in a set.

CHECK ON CONTROLS

Speaking in more general terms once more, and covering both AC and battery sets, it is a good idea at this stage to go over the various controls; volume, tone, wave change, &c., and check electrical and mechanical efficiency. In the case of potentiometers, noise is the most likely trouble and some careful observation here may assist in predicting their future performance. If they are perfectly quiet one can only assume that any ultimate failure is some indeterminate distance away and that they are best left well alone.

On the other hand any noise, even if it is too low to be noticed by the average owner, indicates that trouble is on the way and that it is far better to replace them now than risk their failure in the near future. At the same time check the knobs for proper fit on the shafts, check the grub screws, if these are used, or any patent spring fitting to make sure that the knobs will remain firm after they are fitted to the shaft.

Controls involving switches can also give trouble and it is not unusual to find that old sets are quite bad in this respect. What usually happens is that high resistance joints develop at the various contacts and these, being in the early stages of the set, produce a lot of noise when the set is subject to even moderate vibration. At the same time the gain of the set can vary, giving rise to intermittent effects. In extreme cases the vibration of the speaker can be sufficient to cause trouble.

In some cases this trouble is simply due to lack of use (we all know the old story about the short wave section never being used after the first week of ownership) and a few drops of carbon tetrachloride cleaning solution, together with a few movements of the switch, is all that is necessary to cure the trouble.

REPLACEMENT BEST

In other cases, particularly where the set has been used in country areas and where the short wave section is really used, it is due to straight out wear and the only really satisfactory cure is to fit new wafers to the switch. This is usually a fairly big job, often involving much dismantling before the switches can be "got at", and it is usually advisable to get the owner's OK before going ahead if anything as formidable as this should crop up.

Where the short wave facilities are no longer needed the various contacts can be shorted out and, providing the owner is fully aware of the situation, it is often a happy solution. Alternatively one can only clean the contacts as above and hope that they will perform satisfactorily. In such cases be sure you cover yourself by explaining the situation clearly to the owner.

Another cause of noise in the tuning portion is foreign matter between the gang plates. In this case the tuning of the set may be accompanied by crackling which can be particularly annoying on short waves. Sometimes the trouble is due to ordinary atmospheric dust and sometimes due to small metallic particles. The latter, in turn, is generally caused by inferior quality metal which has been plated. The plating eventually peels off, causing short circuits between the plates.

DIRTY GANGS

The popular method of cleaning dirty gangs is to "burn them out" by applying a moderately high voltage, from 45 up to the set's own HT voltage, through a suitable dropping resistor. Rotating the gang a few times with the voltage applied will usually destroy the offending particles. However, don't, in any circumstances omit the resistor otherwise you can easily damage the gang if there is a bad short. One character I know once tried this stunt (with only a rough idea of what was involved) using no less a source of power than the AC mains. The result was a gang with the rather novel feature of welded plates, a blown fuse, and a badly shocked and shaken character. Needless to say he learned a very effective lesson.

Another component which is always suspect in any set is the electrolytic condenser. These cannot be regarded as having as long a life as the average paper condenser or resistor, and thus should be checked whenever possible. Unfortunately they are difficult to check by ordinary means, though the more elaborate multi-testers usually have facilities for checking both leakage and impedance, the two characteristics which change when these devices are "on the way out".

In the absence of such facilities one can only judge their condition by the performance of the set as a whole or, in some cases, by their appearance. Where there is any indication of leakage of electrolyte, swelling or bulging of the ends, or other obvious signs of distress then it is best to be on the safe side and fit a new one.

HT BYPASS

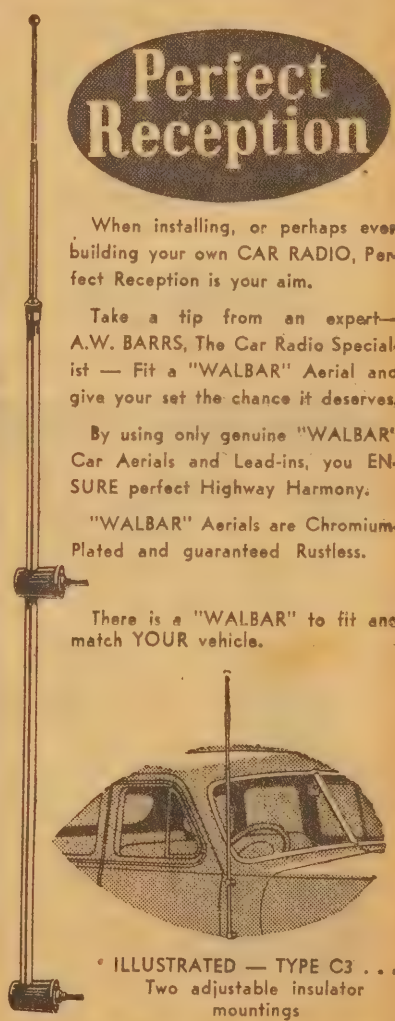
Although involving the question of design rather than repairs it is a good idea to check whether a paper condenser has been fitted across the HT line, particularly if the set shows signs of instability. Electrolytics are not designed to work at RF and frequently fail badly after a short while Nevertheless, many cheap sets were marketed at one time without this necessary precaution.

As a matter of fact I had such a set on the bench only a few days ago and, believe it or not, it carried the brand of one of our largest manufacturers. The fault was a severe high speed motor boating, plus a high pitched audio oscillation, the general effect being an excellent imitation of a batch of day-old chickens.

A .5 mfd from the HT line to chassis immediately cured the trouble and the set performed quite normally. Further investigation showed that there was a very slight hum in the output which vanished when the second electrolytic was replaced. This was also sufficient to cure the instability, but I fitted the .5 also a justifiable modification.

Another defect in many old sets is the use of poor quality wire wound resistors. These were wound on low grade composition former which shrinks after a few years, leaving the fine resistance wire hanging loose in a tangled mass of overlapping turns. The same remarks apply to voltage dividers.

Some old type resistors also had very poor connections where the resistance wire was attached to the metal clamp at the ends. These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were supposed to be soldered but apparently the quality of wire and the operator's skill was of a low order in those days and the more usual result was beautiful dry joint.

I'm not suggesting that all old time resistors should be changed but it is a good idea, where you know from experience that a particular type is of very poor quality, to fit one of the much more reliable modern types.

Valve cans, due to poor fit, corrosion, or other causes, can cause instability by failing to "earth" correctly. Even without any obvious signs of such troubles it is advisable to check these parts. In some cases sets have even been found with one or more of such cans missing. (Why? Well your guess is as good as mine).

GENERAL PERFORMANCE

With all the foregoing checked you can consider testing the set for general performance. The first stage of this consists of the usual alignment check and this should provide a wealth of information about the set's performance. Most important of all, it will indicate the sensitivity of the set overall and of the various individual front end stages. Any departure from the normal will indicate something which is not as it should be and will usually lead to some obscure fault which has been missed thus far.

If the alignment can be carried through without a hitch it is a fairly good omen and the next stage of testing on general performance is a straight out listening test. To the academically minded a listening test may appear somewhat indefinite and inconclusive, being so much dependant on the skill and experience of the observer. This is perfectly true, and it is also perfectly true that, theoretically at least, it should be possible to reduce all tests to a matter of finite measurement.

In practice such tests would be hopelessly clumsy and expensive without achieving a very much greater degree of accuracy, at least from a practical point of view, than can be obtained by careful observation. In other words, the skill and experience which the serviceman acquires over the years is one of his most valuable assets and the very thing which makes him a serviceman. It is, in fact, the reason why a set owner is prepared to pay him to service his set.

AUDIO QUALITY

After that little piece of philosophy we will return to the practical aspect. In order to ensure that the listening test is really effective it is advisable to consider, in turn, each of the characteristics which should be checked Probably the first thing to be checked is the audio performance for freedom from distortion and hum. In all but the very smallest mantel sets there should be reserve of volume available without any appreciable distortion and which should be enough to produce an uncomfortable feeling in any normal room. However, where very small speakers are used, care must be taken not to overload them since there is often more audio power available than they can handle.

The test for distortion also takes into account the loudspeaker and it is advisable to test this for possible hessing if it is one of the older electromagnetic type. Since any slight mis-alignment may not show up until the speaker is hot it is advisable to make this test after the set has been running for a reasonable time, and preferably in the cabinet if it is an enclosed type.

Hum should be checked in a quiet room, under no signal conditions, and with the speaker baffled in its normal manner. Most commercial sets have a somewhat higher hum level than the average high fidelity enthusiast would pass but, nevertheless, it should be quite inaudible at more than two or three feet. In the case of mantel sets which are often used at very low levels a few inches from the listener the requirements are more stringent.

Only experience will tell you whether a particular brand of set has an unusually high hum level (due to poor design) or whether you have an individual case which is faulty. In any case it is advisable to do what can be done to improve matters providing the expense is not likely to embarrass the owner. If in doubt this point should be clarified first.

In the case of radiograms there will be a number of connecting cables between the chassis and the motor board, some carrying 240 AC, some power for indicator lights, and, of course, the pick-up lead. All these should be checked as should also any plug and socket connections used to connect them. As with the mains power cord, any other power cords with faulty insulation should be replaced.

RECORD CHANGERS

Where a two or three speed motor is used the speed change device should be checked and a record changer should be put completely through its paces, checking that it changes, stops, rejects, &c., in accordance with the designer's intention. If repairs are necessary you will have to decide whether to tackle them yourself or return it to the makers. Much depends on the nature of the fault and your experience with similar devices. The important thing is not to return it to the customer in a faulty condition.

Although an experienced worker can judge the power output of an ordinary set with reasonable accuracy there are exceptions where it may be advisable to measure this characteristic. This applies particularly to high power PA installations which have obviously been designed to deliver a lot of watts. Since the ability to deliver high power is their main function in life such systems should be given an accurate power output measurement. Otherwise they may perform perfectly on the bench and fail hopelessly in their proper situation.

Returning to the set proper it is necessary to observe the performance when it is tuned over the band, checking for oscillation, joeys, interference between stations, cross modulation and similar defects.

As well as checking the electrical side of the set there should also be a thorough overhaul of the mechanical sections. As far as the owner is concerned these are every bit as important as the valves and resistors. To him a fault is a fault, no matter whether it is a burnt out dial lamp or a faulty filter condenser. Since it is easier to observe wear and tear and predict failures in the case of mechanical sections these should be treated in detail.

One of the most important of these is the dial. If it is a cord drive (as is usually the case), examine the cord for any signs of wear. If there is any doubt it is better to replace it with the best quality cord availablle. Remember that a broken dial cord can put a set out of action just as effectively, as far as the average owner is concerned, as a faulty valve.

DIAL LUBRICATION

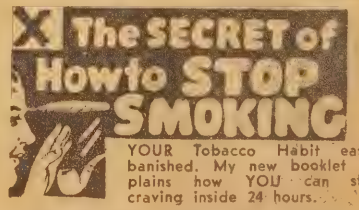
The lubrication of the dial should also be checked and any grease which has hardened removed with methylated spirit. Whether fresh grease should be applied is largely a matter of opinion, but there are many cases where the dial performs perfectly in the dry state and there is then no chance of it "gooing up" again at a later date.

It is a good idea to clean the dial glass, removing it if necessary, but be very careful not to damage the markings. This is particularly so in the case of old glasses, where the paint has become hard and powdery. Care is all the more necessary, because old glasses are usually very difficult to replace. Naturally the dial calibration will have been checked during the alignment process, but it should be given a final check when the glass is replaced.

The dial lights should be checked and any faulty ones replaced. Loose ones should be tightened and sealed in place with a spot of lacquer. Any lamps which are still functioning, but which are badly blackened, should also be discarded. Apart from giving a poor light, it is reasonable to assume that they have given most of their useful life and will not last much longer. The replacement is cheap when it is done as part of the overhaul, but will be dear if it creates a special service call.

GENERAL CLEANUP

Finally, the chassis and cabinet should be cleaned and the whole set reassembled to look and perform as nearly as possible as it did when new. If the job has been properly done it should now be safe to say that all predictable faults have been taken care of and that, as far as is humanly possible, the set has been made trouble free for at least 12 months.



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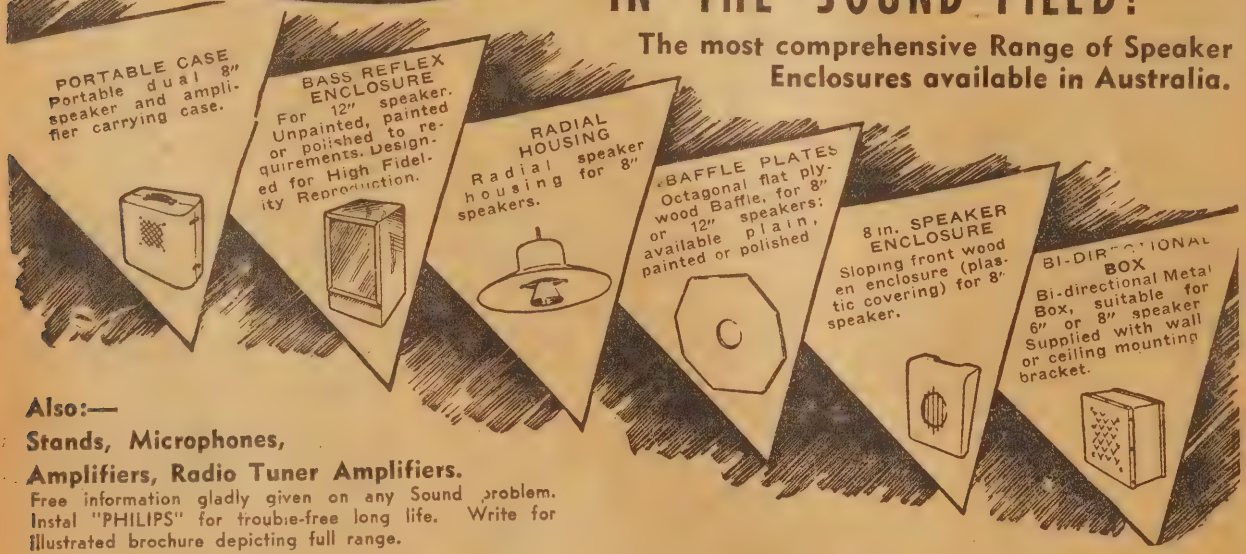
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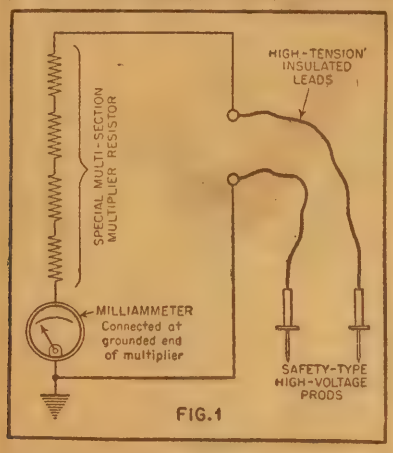
The normal range of radio and amplifier tests seldom calls for the measurement of voltages higher than 1000, and ordinary self-contained multimeters are adequate for the purpose. This article by Aerovox Engineers describes the measures which are necessary to check voltages substantially higher than 1000 volts.

A CURSORY survey of high voltage measurements will indicate that several common methods of measurement are employed to suit individual voltages and test conditions, and, in most cases, that one system may be used to check or standardise the other.

The common systems now being used for measuring high voltages include (1) meters designed specifically for high-voltage tests, these including electrostatic kilovoltmeters, and d'Arsonval type kilovoltmeters (with and without external multipliers); (2) special external multipliers, voltage dividers, and potential transformers for converting low or intermediate range voltmeters or milliameters into kilovoltmeters; (3) electrometers which find their most extensive use in experimental laboratory work; (4) special spark gaps, including sphere gaps and needle-point gaps; and (5) step-up test transformers (often in conjunction with electronic rectifiers) of known turns-ratio to which known values of low primary voltage are applied.


HIGH-TENSION INSULATED LEADS
SPECIAL MULTI-SECTION MULTIPLIER RESISTOR
MILLIAMMETER Connected at grounded end of multiplier
SAFETY-TYPE HIGH-VOLTAGE PRODS
FIG.1

NOT ONLY SYSTEMS

The writer does not wish to imply that these are the only systems available for the measurement of high voltages. The instruments and systems listed are commonly used, however, and are highly practical.

Commercial d'Arsonval type meters, having sensitivity of 1000 ohms per volt, are supplied regularly without external multipliers for full-scale DC deflections up to 1000 volts.

From 1 to 5 kv full-scale deflection, these instruments are often supplied for use with external multipliers and can be furnished for higher values on special order.

It is even possible to obtain entirely self-contained portable kilovoltmeters with 0-5, 0-10, 0-20 kv ranges. These instruments are essentially low and medium range milliammeters, with high-resistance series-connected multiplier resistors internally mounted.

Ceramic - insulated high-voltage input terminals are provided, and well-insulated safety-type test prods and leads are included as essential accessories.

Another approach is the supply of special close-tolerance multipliers for use with 0-10 DC milliammeters (with thermocouples for AC operation) to measure potentials up to 25 kv, AC and DC. In the 1-25 kv range, the multiplier current is 1 to 5 milliamperes and the accuracy of calibration of the multiplier resistance is 0.1 pc.

Any low-range movable-coil milliameter may be converted into a practical kilovoltmeter by connecting in series with it an appropriate high-resistance multiplier. Panel-mounted instruments on high-voltage power supply units are often so arranged. Connections are indicated in Figure 1.

RESISTOR VALUE

The value of the resistor may be determined from Ohm's Law, R equals E/I; where R is the required multiplier resistance value (ohms), E the desired full-scale deflection (volts), and I the present full-scale current deflection (amperes).

This multiplier must have a large enough wattage rating to dissipate with ample safety factor the power (I sq R) developed by the maximum full-scale meter current flowing through it, and must be as long as possible (preferably being made up of several component resistors connected in series and embedded in a high-grade wax) to minimise surface leakage and prevent flashover.

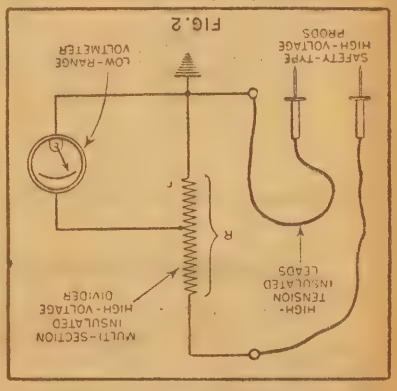
It is highly desirable to mount such resistors in an overlength glass tube after they have been connected together and to mount the entire assembly well clear of other circuit components. The mounting must be rigid mechanically and must not require that the pig-tail leads of the end resistors act as supports.

CHART I
NEEDLE-GAP SPARK-OVER VOLTAGES
(At 25°C., 760 mm, 80% R.H.)

RMS KILOVOLTS	MILLIMETERS
10	11.9
15	18.4
20	25.4
25	33.0
30	41.0
35	51.0
40	62.0
45	75.0
50	90.0

High-resistance, movable - coil voltmeters may be converted into kilovoltmeters by means of voltage divider potentiometers (see Figure 2). This is the same conventional arrangement employed in some low-voltage instruments of the electronic type, except that the resistance ratios are arranged for higher-voltage division.

In this circuit, the ratio of the fractional resistance, r (across which the meter is connected) to the total resistance, R, corresponds to the ratio of the normal full-scale meter deflection to the high voltage applied across R. If the section r is made variable, as by tap-switching, several kilovolt ranges may be provided for a single meter.



The potentiometer method has the disadvantage that the meter resistance must be considerably higher than the section resistance, r. In some instances, this will limit the total resistance value, R, which for best results must be of a high order of magnitude to prevent excessive loading of the high-voltage source.

POWER DISSIPATION

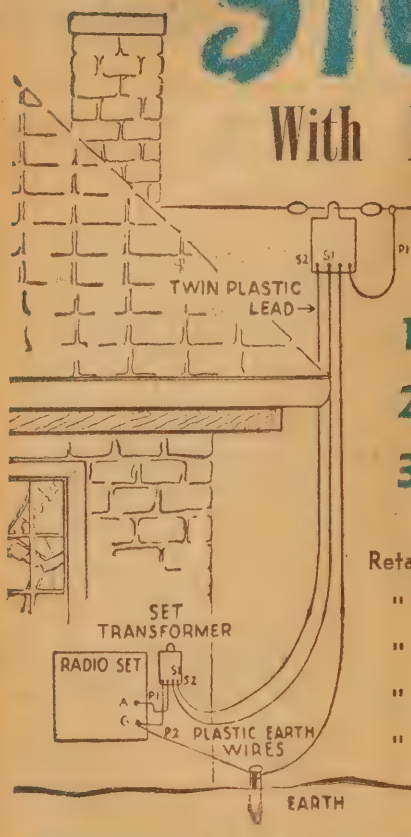
R must be capable of dissipating with ample safety factor the power (I sq R) developed by current flowing through the entire resistor; and like the series multiplier, must possess the greatest practicable length in order to minimise surface effects and prevent flashover.

The highest range of an electronic voltmeter (generally 1000 volts) may be extended successfully to several kilovolts by the potentiometer method, since the vacuum-tube instrument possesses extraordinarily high input resistance and permits the highest values for R.

Several important safety precautions must be observed when em-

STOP NOISE IN YOUR SET

With R.C.S. aerial and line filters

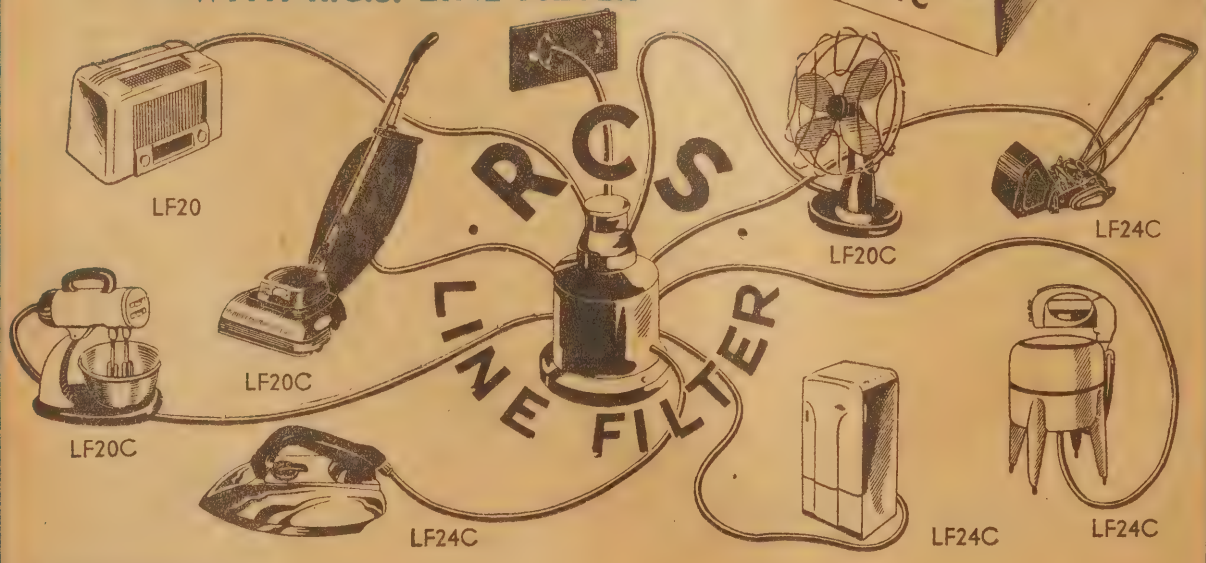


MAKE THIS SIMPLE TEST:—

1. Remove aerial from set. If the noise stops, you need an AF21C aerial filter, as the noise is coming through your aerial.
2. If the noise continues, you need an LF20 line filter as the noise is coming through your power main.
3. If any of the appliances shown below are causing the noise, then fit to it a line filter of the type shown.

Retail AF21C aerial filter		140/-
"	LF20 line filter ..	37/-
"	LF20C " " ...	42/-
"	LF24 " "	50/-
"	LF24C " "	55/-

CONFINE NOISE WHERE IT STARTS — WITH R.C.S. LINE FILTER



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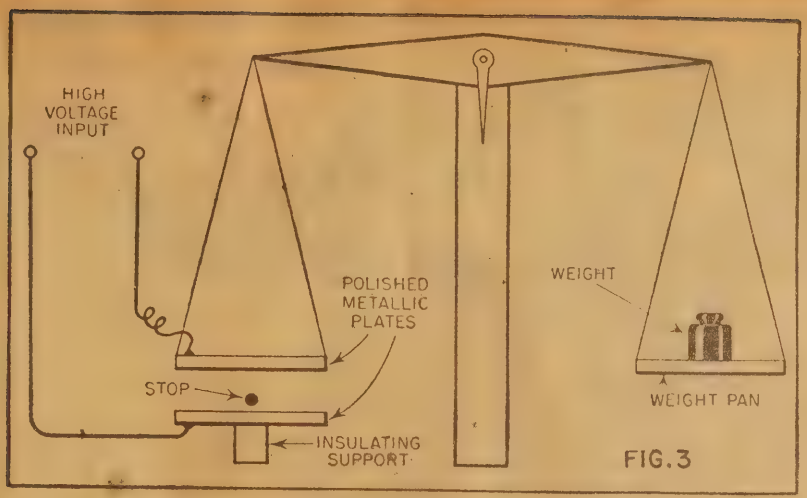


FIG.3

ploying any of the movable-coil kilovoltmeters.

The meter must be connected to the ground end of the multiplier or voltage-divider resistance; meters with "live" zero adjuster screws should never be used; metal-cased meters should be used only in emergencies and then only when mounted back of the instrument panel. Whenever practicable the meter should be mounted behind thick glass.

Test leads should be provided with high-tension insulation, and test prods should be of extra long length and must be insulated by a high-grade hard sleeving throughout most of their length.

Suitable instrument fuses should be connected at the meter terminals and should be held by approved fuse holders supported by some other means than the meter case. Fuses should be provided also at the input terminals of the instrument for protection of the multiplier or divider resistor. A few designers favor paper meter cards over the popular metal scales.

Standard potential transformers are available for converting low-or intermediate-range voltmeters (and some milliammeters). into kilovoltmeters.

These instruments are step-down transformers designed to reduce the maximum high potential to be measured to the lower full-scale value of an available voltmeter. The transformer turns ratio is the factor whereby the meter deflection is multiplied.

TYPICAL TRANSFORMER

A typical potential transformer steps down 4.5 or 9 kilovolts to 150 volts maximum. This unit is supplied for 25 or 50 to 133 cycle operation and is capable of handling 15 or 25 volt-amperes.

Makeshift potential transformers may be any such units whose turns ratio will furnish the required step down of voltages, whose input winding is capable of handling the high voltages and passing safely the attendant current, and whose insulation is capable of withstanding the high voltage.

It is highly desirable that the input winding have as high a DC resistance value as possible, in order to minimise loading of the high-voltage source.

Disadvantages of the potential transformer are its relative weight and bulk, low-resistance input, and restricted maximum input potentials.

When the line voltage and turns ratio of the transformer in a high-voltage power supply circuit are known, high potentials delivered by the supply unit may be determined with sufficient accuracy for many applications by means of the following formulae:

(1) $$E_s = 1.414\ E_p \left(\frac{N_s}{N_p}\right)$$

for alternating voltage delivered directly by the transformer secondary

(2) $$E_s = 1.414\ F E_p \left(\frac{N_s}{N_p}\right)$$

for direct voltage by rectification.

Es is the high-voltage value, Ep the RMS reading of a primary voltmeter connected in parallel with the transformer primary and the supply line, and Ns/Np the transformer turns ratio.

In the DC formula, F is a factor governed by the type of rectifier employed—ie, F is 1 for simple half- or full-wave rectification, 2 for a voltage double, 4 for a voltage quadrupler &c., &c.

The second formula assumes that the power supply is either unloaded, or negligibly loaded (as by a high-resistance bleeder).

The electrometer is an instrument which makes use of basic principles for the measurement of potentials, and is most successfully employed at high voltages. The active portion of this instrument consists essentially of two metallic plates, one stationary and one movable, arranged in parallel relationship with each other and connected to the source of high voltage.

AN ELECTROMETER

Electrostatic attraction, which causes one plate to be drawn toward the other, is proportional to the applied voltage. The diplacement of the movable plate, with respect to its position of rest, thus is likewise proportional to the applied voltage, and the instrument may be employed as a voltmeter for either AC or DC indications.

An elementary electrometer consists of a simple balance, as shown in Figure 3. In this arrangement, a movable metal plate is carried from one end of a beam; a weight pan from the other. The movable plate is suspended above a parallel-mounted stationary plate, and the two are connected to the source of high voltage. An insulating safety stop prevents the two plates from meeting.

Electrostatic attraction tends to draw the plates together, the force of this attraction being measured in terms of the weights which must be placed in the weight pan to maintain balance. The attraction is proportional to the square of the difference of potential. The voltage value is determined by means of the equation:

(3) $$E = d\sqrt{\frac{25.13\ f}{kA}}$$

Where E is the applied voltage
f = force of attraction (measured with the balance)
k = dielectric constant of the material separating the plates (1 for air)
A = area of the smaller plate (if the two are unequal in size)
d = separation between plates at balance

A and d must be in the same class units (inches and square inches, or centimeters and square centimeters)

There are several variations of the fundamental electrometer design, the arrangement just described being merely a rudimentary arrangement which has found frequent application in the absence of other instruments for high voltage measurements.

The electrostatitc voltmeter, like the electrometer, utilises electrostatic attraction between fixed and movable elements to obtain deflections proportional to an applied voltage.

The movable vane in a modern electrostatic voltmeter is mounted on a pivoted spindle which rotates in jewelled bearings against the torque of a spiral spring. Suspension type instruments are also supplied for laboratory use.

The electrostatitc kilovoltmeter, available commercially in both portable and panel-mounting styles, is distinctive in that it draws virtually no current from the high-voltage source. However, its use is limited to DC and to low-frequency AC.

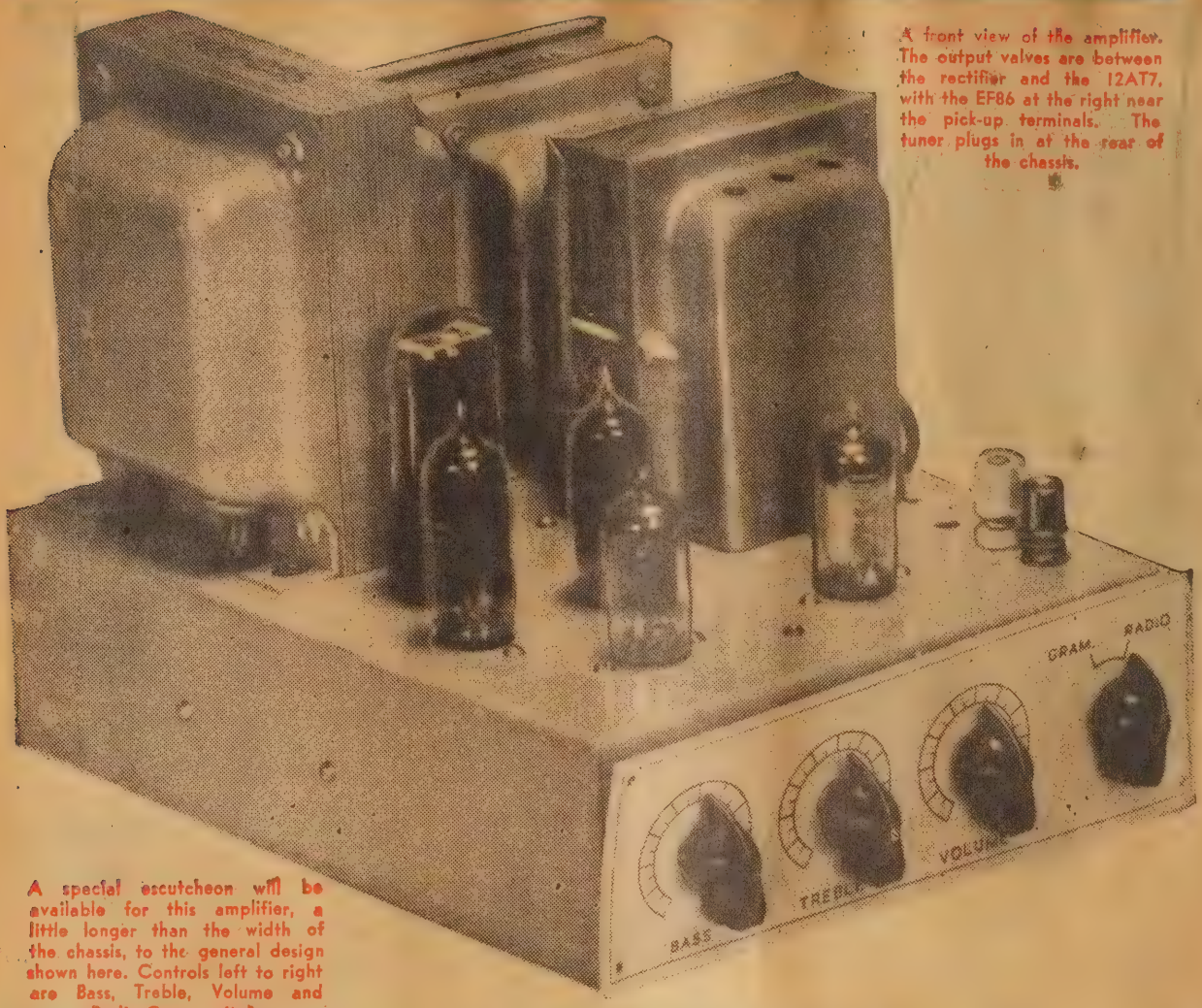
ELECTROSTATIC VOLTMETER

The electrostatic voltmeter is essentially a high-voltage instrument. It rarely is supplied for full-scale deflections of less than 500 to 700 volts, being commonly intended for kilovolt service. Electrostatic kilovoltmeters are supplied for use up to 100 Kv, the higher ranges being obtained by means of capacitor-type multipliers.

The safety precautions recommended in connection with movable-coil kilovoltmeters apply as well to the electrostatic instrument.

High voltages may be measured in terms of the maximum air gap in which spark-over will occur. The accuracy of this method may be en-

(Continued on Page 109)



A front view of the amplifier. The output valves are between the rectifier and the 12AT7, with the EF86 at the right near the pick-up terminals. The tuner plugs in at the rear of the chassis.

A special escutcheon will be available for this amplifier, a little longer than the width of the chassis, to the general design shown here. Controls left to right are Bass, Treble, Volume and Radio-Gram switch.

THE UNIT PLAYMASTER No. 6

Here is a new Playmaster of more compact design and featuring continuously variable tone controls. Both crystal and magnetic pickups can be used, and it should be ideal with the standard 3-speed motor plus crystal pickup combination. All the Playmaster tuners can be operated with it to make a most impressive radiogram.

by John Moyle

MOST of our readers will remember the Playmaster series of amplifiers which was concluded some months ago. It included designs for a number of amplifiers ranging from small three-valve jobs to larger, more powerful types with separate control boxes, and a range of tuners to go with them.

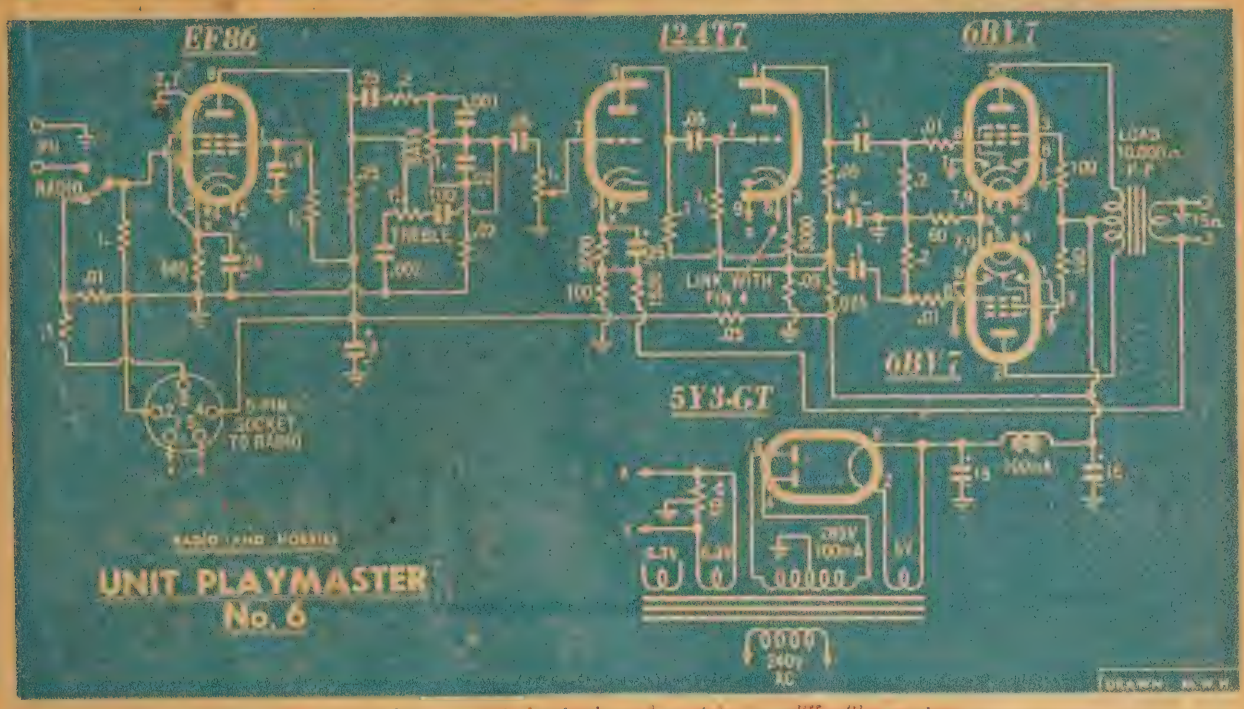
These amplifiers have been particularly successful, and very few troubles have been reported from those who have built them.

The most popular has probably been the No. 2 amplifier, which used a pair of 6V6GT's in push-pull, giving about 10 watts and striking a good compromise between output and price. With this amplifier goes, almost as a matter of course, the No. 2 control unit, which used a single ECC35 dual-triode valve and featured separate bass and treble controls in addition to a volume control and a function switch. This switch selected either microphone, radio or pick-up inputs, the latter having three degrees of compensation to deal with various types of records.

The use of a separate control box is almost a standard procedure nowadays. It makes housing the gear somewhat flexible, as the box can be mounted in places where the amplifier as a whole, couldn't go. It also helps in keeping hum to a low level by reducing the risk of "earth loops" in the wiring.

But, apparently, there are some of our readers for whom the total size of the equipment is too large or too inconvenient, or otherwise not suitable for what they wish to do. That's not surprising, because a feature of the home-building business is that we can use designs to do the work the way we want it done, and if

CIRCUIT DIAGRAM OF UNIT PLAYMASTER No. 6



The circuit is comparatively simple and contains no difficulties or traps.

we don't like them, we can pull the bits to pieces and wire them some other way. We don't have to take what is available and make it do, if we'd like it in some other form.

A second scheme seems to appeal to some readers and that is to make the treble and bass controls continuously variable instead of switch-operated. This seems to be popular in some commercial equipment, the idea being that often the listener isn't so much concerned with exact compensation curves as with setting the knobs for just the amount of bass or treble he happens to like.

This scheme gathers some weight from the bewildering variety of recording curves now being used by record manufacturers. It is so great that a case can be made out for a super control switch providing for numerous combinations of bass and treble plus cross-overs to cater for them all. The trouble is to know which is the right one to use.

SIMPLE WAY OUT

The continuously variable approach to which I am referring prefers to adopt the simple way out by setting controls until the record sounds good, and leaving it at that. For the average person, there is much to be said for it. My only criticism is that I like to know that, in a given position, the amplifier conforms to a certain curve which is known, but I must admit that to many, such knowledge wouldn't have much significance. As a matter of fact, I have been impressed by the good results many listeners achieve by using the simplest kinds of top control to compensate for the micro-grooves. This is particularly so when pick-ups are used which are inherently far from "flat" such as the popular crystal types. The task of compensating adequately for these is such that the principle of adjusting bass and treble until it "sounds right" appears to do much better than one would think. Elaborate compensation tends to become somewhat futile unless the pick-up is good enough to give us something to work on.

A NEW CIRCUIT

However, all these things produced the idea of sketching out a new Playmaster which would retain all the original features of reliability, simplicity and high quality, but with amplifier and compensation controls mounted on one smallish chassis. As the principle of continuously variable controls seemed to go with this idea of simplification, we thought we would include this as well.

The result was an amplifier which is good enough to upset somewhat our fixed ideas about separate units. It hasn't quite as much output as the largest models, but it runs about 8 watts, which is plenty for people with normal ears. It runs with about 20 db of feedback to keep distortion to a low figure, and shows no sign of instability, even with a greater amount. Its hum level is very low — quite comparable with that of other Playmasters—and its sensitivity, even with 20 db of feedback is about 80 mv, enough to make plenty of noise with even medium output magnetic pick-ups. Reducing the feedback to about 13 db improves sensitivity to about 40 mv. Either con-

PARTS LIST

1 Chassis 9½in x 7in x 2½in.
1 Power transformer, 285V at 100 mill, 5V and 6.3V filaments.
1 Filter choke 15 henries at 100 mills.
1 Output transformer to suit speaker, 10-15 watt.
4 Noval valve sockets, 1 Octal socket, 1 5-pin socket, 1 speaker socket and plug.
1 2 position single pole switch (portion of standard rotary type).
3 1 meg potentiometers.
1 Escutcheon plate.

VALVES.
EF86, 12AT7, 26BV7, 5Y3-GT

CAPACITORS
2 16mfd 525 PV electrolytics, 2 8mfd 525 PV electrolytics, 2 25mfd 40 PV electrolytics.
1 .5mfd paper, 1 .25mfd paper, 2 .1 mfd paper, 2 .05mfd paper, 1 .02 paper, 1 .002mfd, 1 001mfd paper, 1 100 pf. Paper types at least 350v working.

RESISTORS
3 1 meg, 1 .25 meg, 3 .2 meg, 2 .1 meg, 2.05 meg, 1.02 meg, 3.01 meg, 2 3000 ohms, 1 1500 ohms, 1 680 ohms, 3 100 ohms, 1 60 ohms, 3 watt, 1 25 ohm CT WW resistor optional. The decouplers (1 .05 and 1 .025) should be 1 watt—others ½ watt except WW types.

SUNDRIES
4 knobs, mounting strips, grommet, 6in shielded wire, hook-up wire, nuts, bolts, solder, etc.

"ACOS" CRYSTAL MICROPHONES

MICROPHONE TYPE MIC 22

Mic 22 is available in 2 types.
Mic 22/2 being complete with desk stand as illustrated.
Mic 22/1 consists of the microphone with nickel plated stem at the end of which is fitted a screwed adaptor which will fit British or American type standard floor stands.
Mic 22/1 can also be used as an effective hand microphone.

MIC 22
PRICE
£9/18/6

SPECIFICATION

Output impedance . . . Equivalent to approximately .002 MFD. (.8 megohm at 100 cycles)
Omni-directional.
Frequency response . . . Substantially flat from 40 to 6,000 cps.
Recommended load resistance . Not less than 5 megohms
Output level . . Minus 50 db below 1 bolt/bar.

MIC 28 LAPEL MICROPHONE

Impedance 100,000 ohms at 1,000 cps.
Capacity .0015 mfd at 24 deg. C.
Output level approximately .55db. Ref. 1 volt/dyne/cm2.
Recommended load resistance not less than 5 megohms.
This small non-directional microphone has been designed to allow freedom of movement for public speakers or broadcasters. The dimensions of the MIC 28 are 1 9-16in. wide by 2¼in long by 5-8in thick. It is housed in a soft moulded rubber case which gives added protection against shock. The microphone hooks on to the lapel of a suit or coat. A 6' cable is supplied The MIC 28 has a level frequency response throughout the whole of the audible frequency spectrum, and consequently gives excellent fidelity of reproduction.

BACK

FRONT

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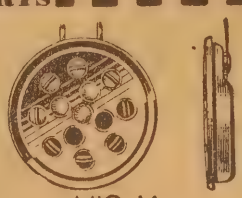
MIC 3

MIC 3. Diaphragm - actuated Crystal Microphone specially designed for the reproduction of speech frequencies with rising response from 1000 c/s, this microphone has exceptional sensitivity. Overall dimensions 1¾in. Price 39/3.



MIC 14

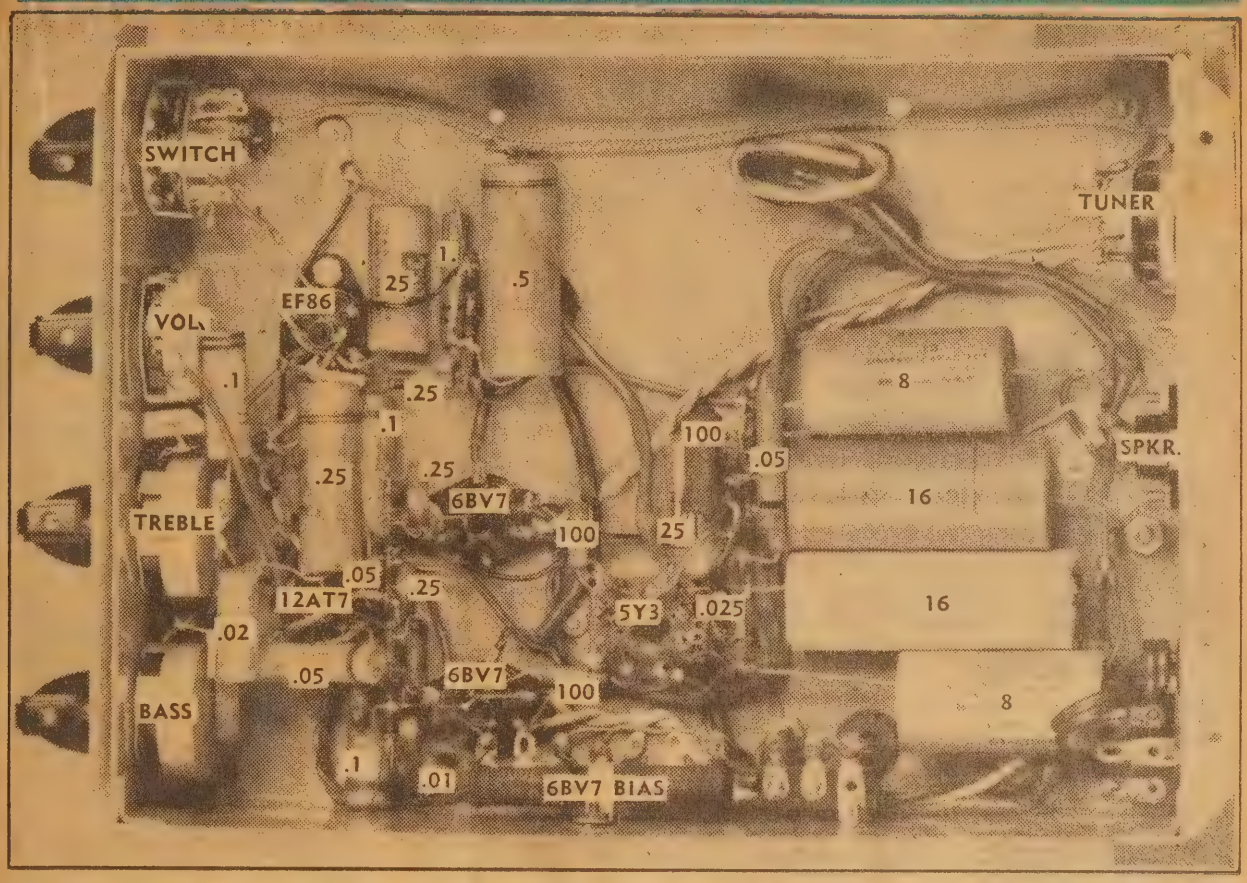
MIC 14. Standard Speech Microphone itself, with nicket plate brass case, which gives high corrosion resistance, mechanical strength and rigidity. Overall dimensions 1-7/16in. Price 39/3.

MIC 18

MIC 18. Microphone Speech insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required, this insert is recommended. Overall dimensions 1-7/16in. Price 39/6.

MIC 32. Sintercel fulfils the requirements for a flat insert with good sensitivity and a frequency response 30-7000 c/s. Unaffected by vibration, exceptionally robust construction. Overall dimensions 1-7/10in. Price £2/15/6.

LOCATION OF COMPONENTS UNDER AMPLIFIER



This picture shows the general layout, and the position of many components as they appeared in the original. Note sockets for the tuner and loudspeaker connected at the rear of the chassis.

dition represents far more sensitivity than required for most crystal pick-ups, and allows for a drop in output if a compensator pad is used (as with our design for the GP20) and for the use of higher amounts of feedback if desired.

Only five valves in all are required for this, due to the use of specialised types, and the chassis is smaller than that specified for the push-pull Playmasters, which, of course, didn't include the tone compensation stage. The amplifier can be used with any of the Playmaster tuners and is suitable for the highest grade of loudspeakers.

COMPACT LAYOUT

The small chassis size calls for somewhat compact layout, but there is no real difficulty in fitting things into place. There are so many good types of miniature components available now that we can perform structural feats hardly possible years ago, and with equal if not better reliability.

The amplifier has been built and used for some months now, and has even been duplicated by one or two readers to whom we gave the circuit. One of them records his reactions in a short statement included with this article, and he seems to like it as much as we do.

Here, then, are the constructional details. We feel this amplifier will fill out the Playmaster series in a useful manner without competing with previous designs, or just being "different" for no specific reason.

The design breaks up into two main sections for obvious reasons—the amplifier proper and the tone compensation stage. Both these were to use the fewest valves possible, and therefore we looked around for suitable high-gain types.

The output stage used a pair of 6BV7 valves which are now readily available. These are high-slope output pentodes, two of which will give about 8 watts to the voice coil, and require only about 10 volts drive. They are excited by a conventional plate-cathode phase-splitter, possibly the simplest and most effective of all, using half a 12AT7 valve. The other half is used as a triode amplifier which accepts the output from the tone compensator stage.

USEFUL GAIN

This combination as it stands gives appreciable gain, for the 12AT7 in this instance will give a gain of about 25 times, and an output of nearly 40 volts. As the output requirement for full volume is only 10 volts, and as mostly the amplifier will be run at only a fraction of this maximum, the distortion will be very low in this stage.

Using negative feedback around the entire amplifier from voice coil to the cathode of the 12AT7 amplifier section reduces this distortion still further—for 20 db it is only 1/10th of its original value. These are generalised figures, but they indicate that the total distortion in the entire amplifier section will be very low.

The virtue of using feedback from the voice coil is that the action of

REPORT FROM THE FIELD

"I have built up the circuit you gave me, the only difference being that I used a pair of 6BJ5 valves I happened to have. These as audio amplifiers are similar to the 6BV7. I had no difficulty in getting it to work, and it is a little beauty. It sounds every bit as good as my earlier Playmaster, and the variable controls are quite smooth. After connecting the potentiometers the right way round (!) I cured crowding particularly in the bass control, and it is now nicely graded. The Acos pickup drives it to full volume. Congratulations on another first-rate design."—J.S.

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15 x 18	£9/13/6
20 x 15	£10/13/6

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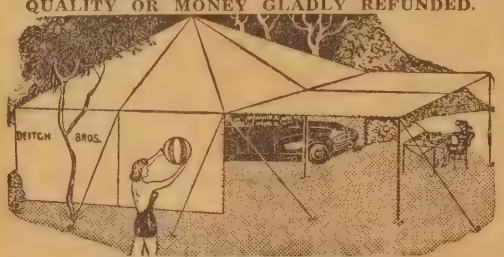

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the feedback loop is able to compensate for the characteristics not only of the valves, but also of the output transformer, the performance of which is effectively improved many times thereby. At the same time, this does not mean that any cheap transformer will become a good one by the use of feedback. An amplifier of this type deserves a good component, which will contribute much to the over-all efficiency, stability and quality.

The output valves are fitted with suppressor resistors in the screen and grid circuits to guard against parasitic oscillation. This is almost a standard procedure with such valves, which otherwise may suffer from parasitics at a very high frequency. They are not always necessary, but it's a wise move to include them from the start.

DECOUPLING

Another precautionary connection is the decoupling in the plate circuit of the phase-splitter. An amplifier using low gain output valves will not have enough amplification in this part of the circuit to allow the small amount of ripple from the phase-splitter plate to be of any consequence. But these output valves are very sensitive, and without feedback, a slight hum may be noticed, despite the good primary filtering. Using decoupling, this hum is virtually wiped out and when feedback is applied, is quite negligible.

The tone compensation uses a single pentode valve instead of a twin triode as in the earlier designs. Not only does this valve give a high gain, lending itself well to the variable tone control feature, but it has an extremely low noise level and complete freedom from microphonic effects. Experience has shown that the miniature twin triodes are sometimes noisy in operation, and are not the best to use in preliminary stages where such things are important.

The specially-made modern pentodes having low noise characteristics are really remarkable in their quiet behavior, and the EF86 is no exception. It also has a Gm of 1.85 which is useful in obtaining gain from a circuit which by its very nature reduces quite drastically the available output from the stage.

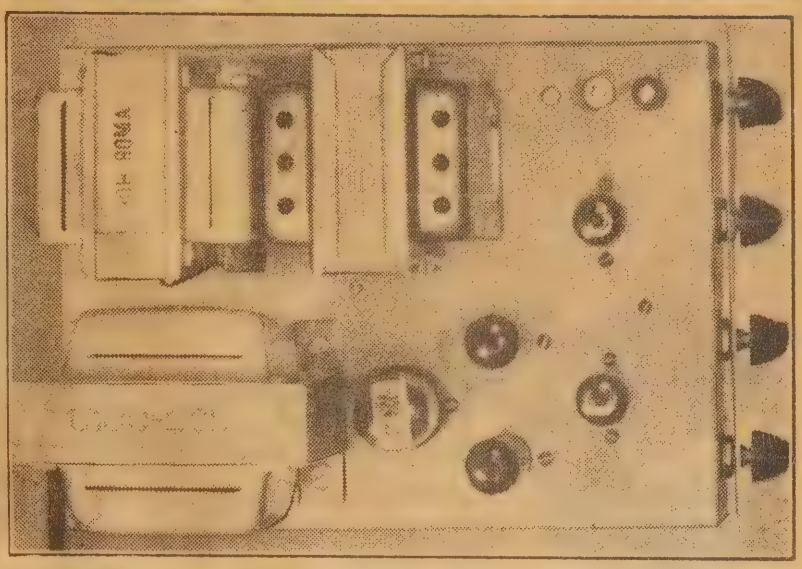
COMPENSATION CIRCUIT

The frequency compensation circuit in the plate of the EF86 is of the voltage divider type. The output is divided down by a system of impedances so that at the cross-over point of 1000 cycles it is reduced about 10 times. By operating the controls, capacitive reactance is added or subtracted to one or other of the divider arms to increase or decrease this gain to provide boost or cut. This circuit lends itself quite well to continuous control, for the capacitances may be fixed in value, and their effect controlled by standard potentiometers.

In the bass control, for instance, when the potentiometer is moved right to the top position, the divider consists of the .2 series resistor, the .02 mfd condenser and the .02 resistor to ground. At 1000 cycles or thereabouts, this represents a straight divider roughly in the proportion of the resistances, as at 1000 cycles, the .02 condenser has very little impedance.

At 50 cycles, however, this condenser has appreciable impedance through its reactance of many thousands of ohms.

AMPLIFIER CHASSIS LAYOUT



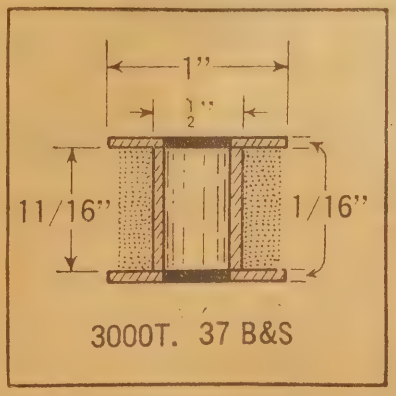
The amplifier from the top. Layouts for the chassis have been sent to the chassis makers in the usual way, and should be available from our advertisers.

Added to the .02 meg which is already present in the bottom half of the divider, the loss in the stage at this frequency is now less than 2-1 instead of 10-1, which means that the stage gain has risen and the bass has been boosted.

When the potentiometer is at the bottom position, the .02 mfd condenser is short-circuited so that there is no boost. In addition, the .001 condenser is now in series with the .25 mfd coupling condenser to the EF86 plate, and as its reactance at 50 cycles is several megohms, there is obviously considerable bass attenuation as a result.

NOT SO SIMPLE

The exact impedance relationships are not really as simple as this, due to the presence of portion of the potentiometer resistance at different frequencies, but the general effect of the circuit is to obtain a variation between these two extremes. The use of a standard logarithmic potentiometer wired the right way round tends to preserve some degree of linearity in its action, at least sufficient to avoid unduly cramping the bass boost effect over a small amount of knob rotation.



Details of the coil required for the Acos compensation pad.

In the treble control circuit, the potentiometer when the moving arm is moved to the right in the circuit diagram couples a .0001 condenser directly between the EF86 plate and the 12AT7 grid, thus allowing virtually the full gain of the former at the extreme high frequency end for treble boost. When moved to the extreme lefthand position, a .002 mfd condenser is connected between the EF86 plate and earth, and as this condenser has only a few thousand ohms reactance at 10 Kc, the gain of the stage is reduced most drastically, and treble cut is obtained. Once again intermediate positions of the potentiometer produce intermediate effects of boost and cut, and correct connection avoids undue cramping of control at either end.

INTERACTION

It is almost impossible with such circuits, in which two opposite effects are "bucking" each other by means of two controls, to avoid some interaction between them. As a result, the frequency response will show a few bumps around the 1000 cycle mark, and the exact cross-over frequency will move about a little according to their exact setting. Although not severe, this effect makes it almost impossible to obtain the absolutely "flat" response of which the amplifier would otherwise be capable. The variations, however, are not more than a few decibels either way. If we made the potentiometers higher in value to reduce this effect, we would crowd their degree of operation into small increments of rotation at the extremes of travel, and if they were lower in value they would begin to upset the impedance distribution of the circuit. Actually, although the circuit is simple in appearance, an analysis of its precise operation would be quite a complicated little problem.

There is no fixed compensation in the circuit. The constants of the bass and treble controls are such that there should be more than enough leeway

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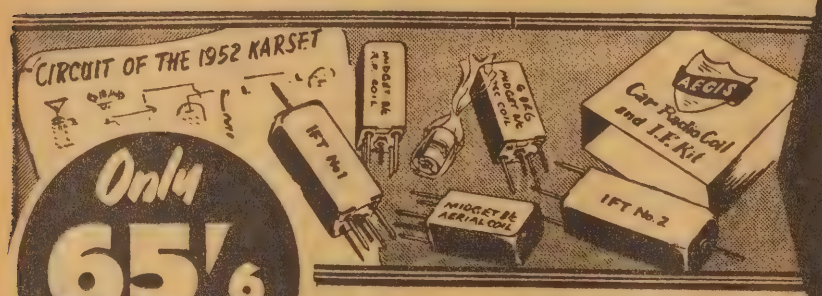

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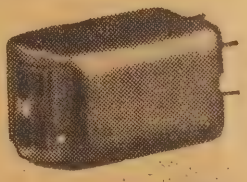

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to make up for normal compensation, and a little to spare. There will not be as much extra bass boost on magnetic pickups as if a separate control unit were used, but there will be some. To introduce fixed compensation would not only cut across the principle of making the amplifier continuously variable, but would also call for more gain in the first instance, with a more complicated circuit.

To use a magnetic pickup, which will generally require about 30,000 ohms load, simply connect it to the pickup terminals with this value of resistor connected permanently across them. Most magnetics will have not less than 100 mv output, and if lower than this, are generally supplied with a transformer to increase output to an appreciable portion of a volt. We are getting plenty of volume using a pickup with only 40 mv output feeding straight into the terminals. Don't forget that it is quite permissible to vary overall gain by varying feedback, without seriously affecting distortion or loudspeaker damping. With a 15 ohm voice coil, 1500 ohms for the feedback resistor will give 20 db, and 2500 ohms will give 18 db. Anything between these two figures should be in order, but there is no point in having more sensitivity than you need to give adequate volume. Use as much feedback as you can.

CIRCUIT DIAGRAM

The circuit diagram is shown with a 1 meg input resistor from EF86 grid to ground as a nominal figure, because we don't know what type of pickup will be used. The 30,000 ohms or so, as recommended by the makers of magnetic pickups, will normally replace this resistor. There is no danger of overloading the first valve under these circumstances.

For use with crystal pickups, however, precautions must be taken to divide down the output to avoid distortion by overdriving the first grid. The GP20 pickup is catered for by the use of a compensating pad, which not only improves response, but also reduces the output voltage to a safe level. The circuit of this pad is given on page 63. It should be shielded and mounted away from the amplifier and phonograph motor to avoid hum pickup.

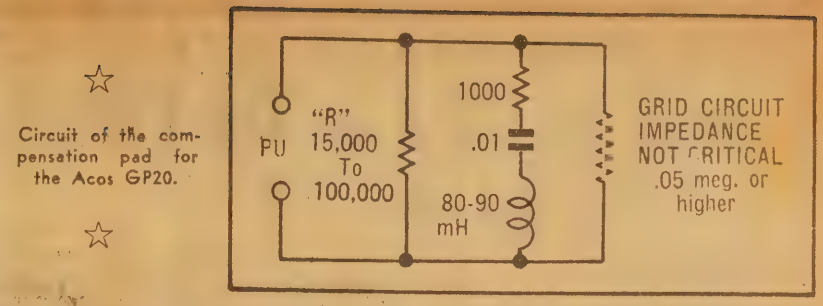
This pad may not always work out with other types of crystals, for which a voltage divider should be used similar to that shown for radio connection in our circuit.

CRYSTAL LOAD

The standard load for a crystal pickup is about .5 megs, which could be the total value of the two resistors. If we play safe, and divide the voltage 10 times, the large value could be .5 megs, and the smaller 50,000 ohms. If this drops the volume too much, this latter value could be increased to .1 megs, or whatever intermediate value works best. Aim at obtaining normal playing volume with the gain control turned about 2-3rds "on", which will give you something up your sleeve for louder moments.

It is a safe rule to cut the output as much as you can consistent with the volume you require. Overloading of the EF86 will show up as distortion on loud passages, no matter what the setting of the volume control.

This total load value of .5 to .6 megs will give full bass output from the pickup, which means that you



Circuit of the compensation pad for the Acos GP20.

may get excessive bass boost from the bass control. This, isn't of itself harmful, but you can reduce the bass by dropping the larger resistor value to, say, .1 megs and the smaller to 10,000 or 20,000 ohms.

This latter set of values will probably give best all-round results.

An even simpler method is to run the crystal pickup into the same value of load as for magnetic pickups, namely, 30,000 ohms. This will reduce its output to about the same level as the average magnetic, and drop the bass response as well. It is probable that no dividing system will be required under these circumstances.

In our amplifier, virtually flat response was obtained with the bass control set to position 4 on the ten point scale for the pointer, and the treble control to position 6. Operating the controls from this setting gave an extreme treble cut of 20 db and a boost of 6 db. The amount of cut is more than adequate for LP records, and the boost ample for any purpose, remembering that treble boost is very rarely required, except perhaps on radio.

The bass boost obtainable is also 20 db, again somewhat more than required, and the cut about 8 db.

When playing LP records with a magnetic pickup, most of the bass boost and treble cut will be used, and with 78 records, a little treble cut and a moderate amount of boost.

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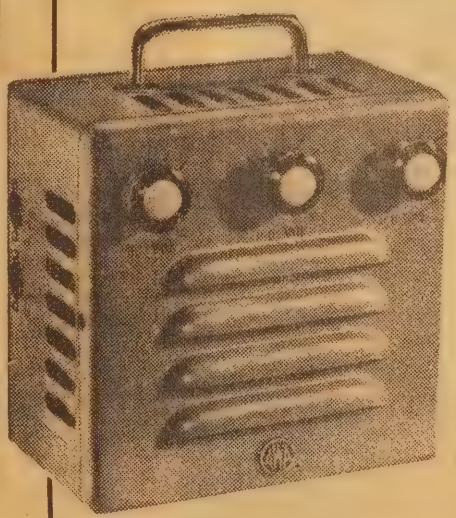

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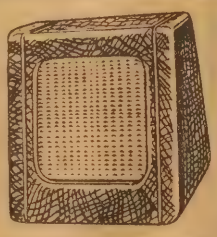

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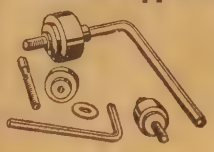

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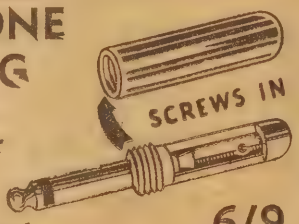

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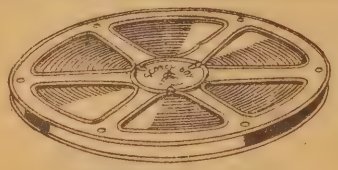

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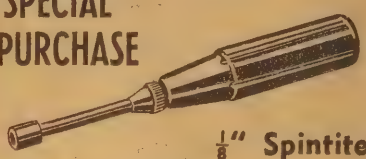

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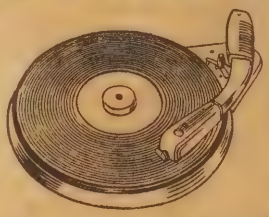

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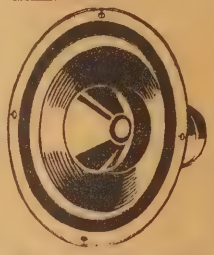

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Crystal pickups will probably need less bass boost than the magnetics and less treble cut, unless the 30,000 ohm load is used, when they may be expected to behave very much like the magnetics.

The amplifier is intended for use with any of the Playmaster tuners, and, as already mentioned, the input circuit contains a suitable voltage dividing network to reduce the tuner output to a safe level. If you live near some very strong stations, you may have to reduce it still further to avoid overloading the EF86. In this case, increase the .1 meg resistor to some higher value.

Some readers have installed a .5 meg volume control in their tuner units to give an added control. At the expense of cutting out the tone control for radio, the tuner could be switched directly to the volume control, but neither of these connections should really be needed.

RADIOGRAM SWITCH

The radio-gram switch may be any type which switches one circuit to two different points—a miniature two or three pole switch is quite OK, ignoring the unused sections. A refinement would be to cut the high tension to the tuner when on the gram position, which will eliminate the possibility of a strong radio station leaking through due to capacitance in the switch itself.

As the photograph will show, most of the resistors are mounted on a strip between the 12AT7 socket and the output sockets. The smaller strip shown above it accommodates the plate and screen resistors for the EF86. The decoupling resistors and condensers are supported by another strip near the rectifier socket, together with the 12AT7 cathode and feedback components. These strips are handy to make a neat, firm job.

EDDY CURRENTS

The amplifier is built on a steel chassis, which also supports the power supply, and there is a possibility of eddy currents being fed into the early stages through earth loops unless care is taken to avoid this. In the circuit you will see that the earth returns for a number of points in the grid and plate circuits of the EF86 are shown connected to the same point. This is a most important constructional feature, and makes certain that none of these circuits depends on the chassis for any part of the earth return circuit. There should be no trouble with earth returns later in the circuit, although there is no harm in grouping those associated with the first 12AT7 section if convenient to do so. However, the gain at this stage may not be high enough for small hum voltages to show up.

The hum level in the final job was so low that only when very close to the speaker itself could any be detected. At normal listening positions the amplifier was completely silent.

The power supply is quite standard. Use a transformer of 100 mills capacity to allow for operating a tuner, as sooner or later you will want it. An extra 16 mfd condenser from rectifier filament to chassis may be used for lowest possible hum level although it isn't really necessary.

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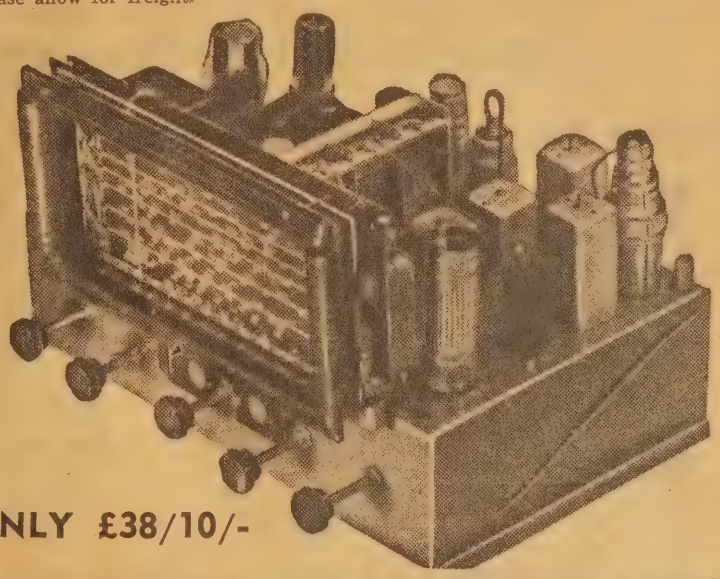
2 valve mantel model radio in leatherette covered case 8in x 5½in x 2¾in with 3½in speaker and batteries, £9/17/6, or in a leatherette covered portable case 9in x 5in x 6in, £10/10/-.

Ideal sets for use in hospitals or as a second set for household use. Battery life approximately 6-9 months. Replacement batteries 22/3 per set. Country clients please allow for freight.



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FOR THIS 8-VALVE DUAL WAVE RADIO

Here's value only to be found at Radio House Pty. Ltd. This readymade and tested chassis is complete with valves and 12in permagnetic speaker. Complete in every detail, it's easily fitted into your radio or radiogram cabinet and can be supplied with a polished wood front panel. Ideal for overseas reception, fitted with phono pick-up terminals, and has two separate tone controls for treble and bass boost. Size 16in x 10½in x 9in high.

SOUND AMPLIFIERS

For Phonograph Pick-up and Microphone

240 volt A.C. models complete ready for use (without cabinet, microphone or pick-up).

3 valve with 8in speaker, £12/17/6 (suitable for phono pick-up only, 3 watt output). 12in speaker £1 extra.

4 valve midget with 8in speaker, £13/15/- (suitable for phono pick-up and microphone 4 watt output). 12in speaker £1 extra.

5 valve with 12in speaker, £21/10/- (suitable for phono pick-up only, 8 watt output).

6 valve with 12in speaker, £25/-/- (suitable for phono pick-up and microphone 12 watt output).

SPECIAL MODELS MADE TO ORDER

6 volt battery-operated 3 valve and vibrator with 8in speaker, £18/10/- (suitable for phono pick-up and microphone 4 watt).

SPECIAL CUT-PRICE LINES AT GIVE-AWAY PRICES

Goldring Headmaster pick-up, £5. Reduced from £12/4/6.
Chassis 3⅝in x 3½in x 1⅞in, 1/6. Panel to suit, 6d.
Collaro phono motor and pick-up, 240v. A.C., £5/5/-. Reduced from £9/17/6.
5 inch permag speakers 7/6 each.
Combination Tool, 10in hammer, pincers, staple puller, 2 wire cutters, wire grips.. Forged steel. German manufacture, 22/6. Reduced to 15/-.
Electron Aerial Wire—two 50ft coils, 4/-.
Chrome swivel head torch, 26/6 complete.
Swiss-made 240 volt A.C. record changers for 8 records—crystal pick-up, £12/7/6.
"Scope" electro-plating set. Plates nickel, copper, tin and zinc, 49/6. Gold, 15/9, or silver, 8/6 extra.
Wizard clip-on Lamp Holder Bracket with ball and socket swivel. All metal. Suitable for workshop or bedlamp, 7/6.
Shop-soiled Stromberg Carlson 3-speed Record Changers, £22/-/-.
English TELSEN 3ft 2-note Door Chimes, £3/9/6. Small Model, 42/6.
Pruning shears, 9in Polished Steel. Imported, 17/6. Reduced to 10/-.
Goldring Gramophone Soundbox Speakers, 15/6. Reduced to 5/-.

All the above can be had by Mail Order, Freight Charges to be added..

RADIO HOUSE PTY. LTD.

296 PITT STREET, SYDNEY

MANUFACTURERS OF COMMERCIAL RADIO RECEIVERS FOR 14 YEARS

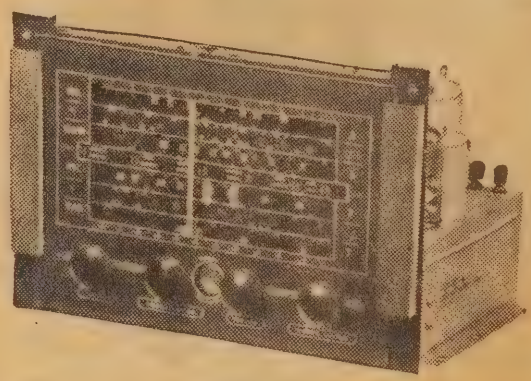
CLASSIC

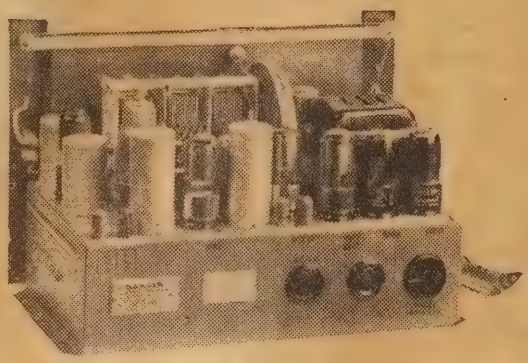
● *World Range* **£33/15/-** *High Fidelity* ●

9-Valve De-luxe Dual-Wave Radiogram-Chassis

Including Magic-Eye Tuning Indicator With Matched Dual Speakers

FREIGHT EXTRA





COMPARE THESE FEATURES

- Ultra modern circuit with new high gain valves and permatuned iron cored coils and intermediates giving good interstate reception and a short wave range of 12,000 miles.
- High gain audio with push-pull output and tone control gives you high fidelity reproduction from both radio and your favorite recordings. Inverse feedback incorporated.
- Power switch is fitted to the tone control of all chasses thus enabling the power to be completely switched off from the set. Radiogram switch combined with wave change switch.
- Tuning is made simple and positive even on overseas stations by the use of a super sensitive magic eye tuning indicator.
- All chasses are wired for the fitting of an F.M. or Tape Recorder. Special plug on back of chassis being provided, also standard 3-pin socket for power supply to motor.
- Speakers supplied are Magnavox 12in and 8in permanent magnet with tropic proof transformer.
- Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations in each State in prominent type, fitted with counterweight drive and indicator lights on dial showing which band in operation.
- Dial can be supplied in cream or brown with matching knobs and escutcheon to suit blond or walnut cabinets.

ALL CHASSES CARRY SIX MONTHS' GUARANTEE.

A New 10-Valve Dual-Wave Radiogram Chassis

The ideal chassis for those difficult locations where reception is doubtful

Specifications as nine valve unit but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

£38/15/-

Large range of Radiogram and Console Cabinets from £12

Record Players and Changers

We have a complete range of 3-speed record playing equipment, including B.S.R. or Garrard Players, with turn-over crystal pick-ups or your choice of Garrard, Stromberg-Carlson, Collaro or the new B.S.R. 3-speed changer that will play 7, 10 or 12in records intermixed. All changers have turn-over Crystal pick-ups.

CLASSIC RADIO

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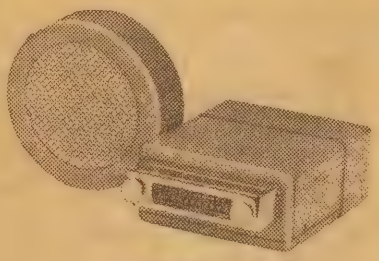
RADIO

FOR QUALITY WITH ECONOMY

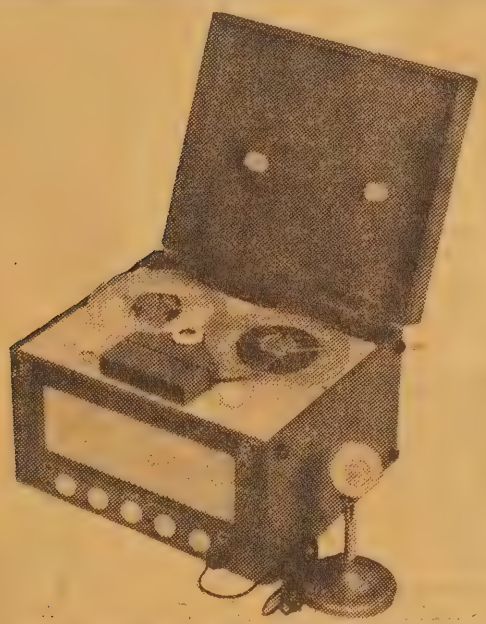
BEFORE BUYING YOUR CAR RADIO SEE and HEAR THE NEW SIX VALVE SET BY CLASSIC

- Long range and selectivity is assured by incorporating modern circuit and using six high gain valves with tuned R.F. stage.
- Battery consumption, 2.8 amps at 12 volts and 4.6 at 12 volts.
- Size has been reduced to a minimum. Set measures 9" x 7¼" x 3¼" deep.
- Both units, set & speaker are finished in bronze hammertone with chrome dial fittings.
- Special dial fittings are available for Holden cars and utilities.
- Heavy duty six or eight inch speaker supplied.
- Set supplied complete with cowl or side mounting aerial and lead.



PRICE **£37/10/-** F.O.R.

"FERROMASTER" TAPE RECORDER



The Ferromaster tape recorder is supplied complete with crystal microphone and stand, and is fitted in durable, attractive plastic-covered carrying case with space for radio tuner, microphone and tape.

PRICE **£99/10/-** F.O.R.

A specially designed radio tuner for the Ferromaster Recorder is available at £9/15/- extra.

The Only Unit with ALL These Features:—

- TWIN TRACK (GIVING TWO HOURS PLAYING TIME ON ONE TAPE).
- DUAL SPEED (7½ and 3¾in PER SEC). SPEED CAN BE CHANGED BY THE FLICK OF A KNOB WHILE UNIT IS IN OPERATION IF REQUIRED.
- FAST FORWARD.
- FAST REWIND.
- POSITIVE BRAKING.
- THREE MOTORS.
- HIGH FIDELITY AMPLIFIER WITH SEPARATE BASS, TREBLE CONTROLS.
- BUILT-IN OVAL SPEAKER.
- INPUT FOR MICROPHONE, PICK-UP. OR RADIO.
- PROVISION FOR EXTENSION SPEAKER.
- RECORDING LEVEL INDICATOR USING "MAGIC EYE".
- TAPE INDICATOR CALIBRATED IN MINUTES.
- FULLY GUARANTEED.

Here's your answer, Tom!

After taking some time to tell Tom about valves, we go back to answering his general queries this month. He has been no less busy than usual and we have quite a few of his letters on file. The range of subjects is so wide that everyone should find plenty of interest in his troubles and their explanation.

PRACTICALLY every schoolboy who has built a crystal set has asked a question similar to our first this month. The answer is almost a stock one with Radio and Hobbies staff. For those who haven't heard it before, here is the answer again.

Could you please tell me if it would be possible to arrange an all-wave radio detector using two or more germanium fixed crystals as detectors.

Yes, Tom, it is possible and, as a matter of fact, is often done, but

there are very good reasons why it is not likely to be practical in your particular case.

There are usually a number of powerful broadcast stations sufficiently close to a given city location to enable programs to be received on a crystal set provided you install a good aerial, have a sensitive pair of headphones, and so on.

DISTANCE IMPORTANT

However, the same is not true of shortwave transmitters. The chances of your being close enough to get a strong signal are not good simply because there aren't as many shortwave stations as broadcast stations and many of the shortwave stations transmitting music and entertainment are deliberately sited well away from city areas.

On the other hand, Tom, if you know for certain that there is a shortwave station within a few miles of your location, its frequency and hours of transmission, it may be worthwhile to go ahead.

The circuit could be the same as any one of our standard crystal sets. There would be little point in using more than the one detector. The coil would have fewer turns than for the broadcast band. Our standard pamphlet on coils for small receivers would give a good indication of what is required.

If you are interested in only the one station operating on one particular frequency, louder signals would result if you used a resonant aerial. A simple dipole aerial would be suitable. Anything more elaborate than this would not be worthwhile because it would be easier to make a receiver with valves.

What are virtually crystal receivers are often used by amateurs for checking their transmissions. They are generally used within a few feet of the transmitter and a short length of wire suffices to give all the pickup required. Sometimes a meter is substituted for the phones so that the device can be used to tune the aerial for maximum efficiency.

CRYSTAL CONTROL

All this is a little away from your original question, Tom, but it does serve to prove that a crystal set will work at higher frequencies.

Could you please explain how crystal control works in a receiver or transmitter?

Glad to do our best, Tom. It would take a long time to go into all the details but a general idea is probably all you want.

A crystal is a slab cut from a piece of quartz. It could be anything from 1 inch by 1 inch by 1/10-inch thick, to a quarter of an inch square and a few thousandths of an inch thick, depending on the purpose and the frequency on which it is to operate.

The crystal is held between a pair of metal plates, usually flat, and wires from these plates go to the external circuit.

If a radio frequency voltage is applied to the terminals of the crystal, little current will flow except at one particular frequency. As the frequency is varied there will be a sudden increase in current and then a decrease in current as the resonant frequency is passed.

LIKE TUNING FORK

The crystal vibrates mechanically in sympathy with the applied voltage and the frequency at which the current increases corresponds with the frequency at which the piece of crystal vibrates most easily. It depends on the physical dimensions of the quartz and is lower for large, thick pieces. As a matter of fact the resonant frequency of a crystal can be raised by grinding it thinner. Fine carborundum powder is usually used.

You can think of a crystal as being something like a tuning fork, Tom. The heavier and longer the vibrating prongs the lower the frequency at which they vibrate. As a matter of fact, where accurate control of an audio frequency is required, a tuning fork is often used.

Don't imagine somebody bashing the tuning fork against the desk as in your school days, Tom. The electronic boys usually keep it going with magnetic coils—much easier when the fork has to kept going for 24 hours per day for years on end.

In practice, the crystal is connected in a circuit where it acts as part of the feedback circuit of an oscillator, so that the oscillator can only operate at the frequency of the crystal.

A feature of the crystal is that its present resonant frequency changes little with variations in temperature, pressure and humidity and mechanical vibration has little effect on its operation. This is in contrast with tuned circuits consisting of ordinary coils and capacitors where elaborate precautions have to be taken to prevent frequency shift. This is a tremendous advantage in

many applications where it is desired to have relatively simple equipment which will remain accurately tuned to frequency.

RECEIVERS

In the case of crystal controlled receivers, Tom, the crystal is almost invariably used to control the frequency of the oscillator section of the superhet. The RF circuits are relatively uncritical and slight mis-

alignment due to changes in temperature, &c., will have little effect. The IF circuits normally operate at a considerably lower frequency than the signal so that a given change in frequency becomes a smaller percentage of the signal frequency than of the intermediate frequency. The crystal becomes more worthwhile at higher frequencies.

Obviously a crystal-controlled receiver will work only on one frequency, as we can't tune the crystal. Such receivers are used in special sets where only one station is required, and will stay tuned to that station indefinitely.

In one of my science textbooks it is stated that electricity flows from the positive terminals of a battery to the negative terminals. However, in another book I find an entirely contradictory statement to the effect that electrons move from negative to positive. Would you please explain, as this has had me puzzled for some time.

It should be interesting, Tom, to get your two professors together and stand by while they fight it out. As a matter of fact, we suggested the idea to our artist who imagined the scene as recorded here.

AN OLD ONE!

But seriously, Tom, there really isn't any argument about electricity and electron flow these days.

An electric current is a flow of electrons and electrons flow from negative to positive.

The effects of an electric current were observed and put to practical use long before a clear understanding of the nature of electricity was gained. A convention had to be established in order that the various rules about the direction of magnetic fields &c., could be established. Unfortunately, the convention subsequently turned out to be the wrong one. The rules had already been firmly established and nobody seemed to be able to change them so that every student of electricity comes up against the same problem.

Some textbooks explains the situation in much the same way as we have done here. Others state that electrons flow from negative to positive but then go on to speak about some mythical substance called electricity, which flows in the opposite direction.

You can accept our assurance that this point will not confuse you as you progress with your studies. We do admit that it is a bit puzzling when you are trying to establish a mental picture of what goes on.

AMPLIFIER CONNECTION

What would be the result if I connected the output terminals of an ordinary broadcast receiver to the input terminals of an amplifier?

You would probably hear the program being received by the receiver in the output of the amplifier. It may be distorted or it may be loud or soft depending on the details of the amplifier and the set. We will explain.

An ordinary broadcast receiver (disregarding the very simplest types) consists of a radio frequency amplifier of some sort, a detector and an audio frequency amplifier. The latter is designed to amplify the weak signal from the detector so that sufficient power is available to operate a speaker. In other words, the receiver already has an amplifier built in.

With the volume of the receiver turned full on there may be several watts of audio power available at the output terminals. If there is no output transformer built into the set, this will be at a voltage of a hundred or more and a fairly low current. Speakers are generally designed to work with a low voltage and high current so that a transformer must be used whether it be mounted on the speaker itself or on the receiver. If the transformer is built into the set the output will be of the order of a few volts.

We speak about the voltage because the input of the amplifier is usually a fairly high impedance and therefore interested mainly in voltages.

AERIAL WIRES

An ordinary crystal or magnetic pick-up would deliver about .25 volt and the input of the amplifier would be designed to accept this with perhaps a little gain to spare. If the leads from the output transformer of the set be connected to the input of the amplifier, the volume controls in both amplifier and receiver could be adjusted so that nothing is overloaded.

On the other hand, if the output of the receiver is at a high impedance, the volume control of the amplifier may not be able to reduce the voltage sufficiently while retaining a smooth control. Either the control would be extremely critical or the amplifier would overload.

The position would be worsened if the amplifier had a very high gain as is required for a microphone. For design reasons, the volume control of a microphone amplifier is usually placed after the first amplifying stage. The first stage can then accept only a small voltage without overload.

INPUT VOLTAGE

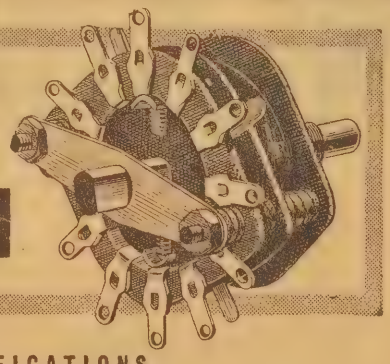
You will realise of course, Tom, that there is no point in connecting an amplifier to the output of a receiver unless the amplifier is capable of delivering more power than the receiver. If the receiver is capable of delivering just as much power as the amplifier, you would get better results by connecting the speakers direct to the receiver itself.

Does the thickness of an aerial wire make any difference to its performance and is there any advantage in using stranded wire?

Assuming that you are talking about an ordinary aerial for an ordinary broadcast or short-wave receiver, Tom, you are not likely to notice the difference between an aerial made from ¼in dia. copper rod and an aerial of the same length made from 40 gauge wire. The main difference as far as you are concerned is that the thick aerial is much easier to handle and erect, although we have heard of people using fine wire which is almost invisible. We should

(Continued on Page 109)

PALEC
Rotary 10 Amp.
SWITCH
(Pat. App. 15243/53)



SPECIFICATIONS

MAX. OPERATING POTENTIAL —1,000 V.

CONTACT RESISTANCE — 800 Micro-Ohms.

TEMP. RISE ON CONTACTS:—
(with 10 Amp. Conductors)
at 10 Amperes 10° rise
at 20 „ 30° „
at 30 „ 50° „

BREAKDOWN VOLTAGE:—
A. Between adj. contacts, 3,000 V.
B. Contacts to earth, 3,000 V.
C. Between O/c. contacts, 3,000 V.

RATING—10 Amp., 250 V.A.C.

CONTACTS—Silver-plated Copper. Non-shorting only.

DECKS—1 to 8.
1 Pole—max. 12 contacts
2 Pole— „ 6 „
4 Pole— „ 3 „
(Special switches to order.)

PRICES (with Standard Clicker)
from: Single Deck—10/- ea.
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plus 12½% Sales Tax. Subject to alteration without notice.
Available all leading wholesalers.

Quantity prices on application to:

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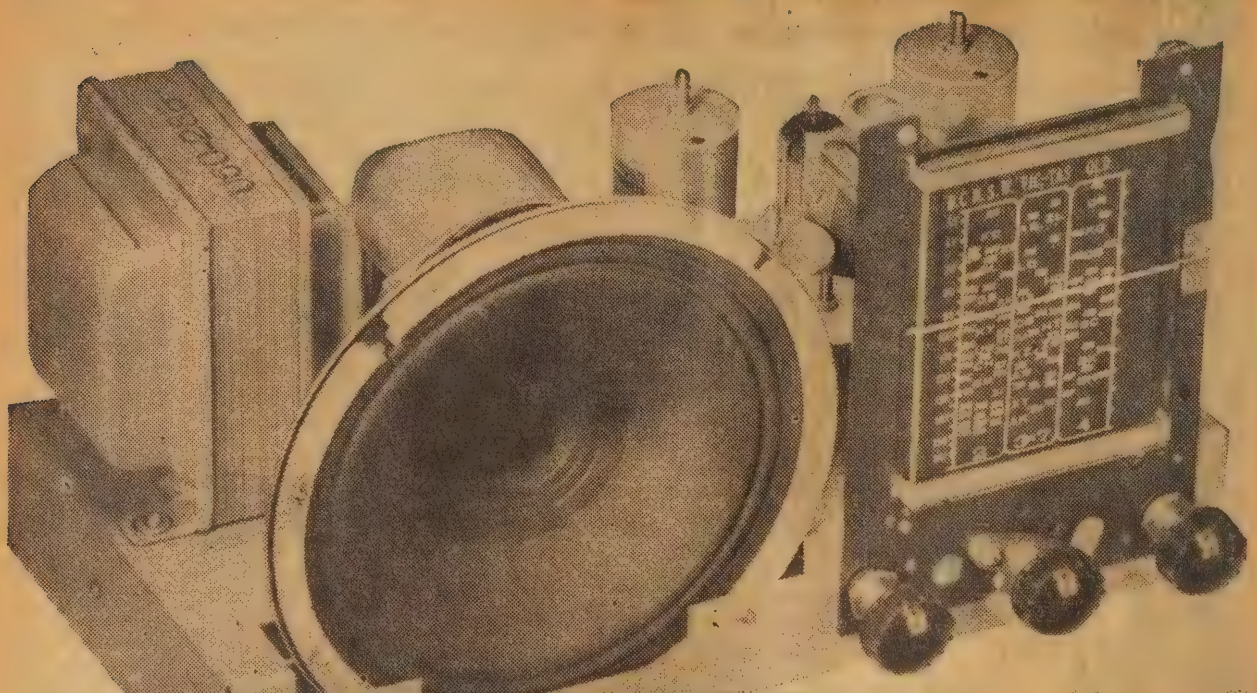


The controls are from the left—volume, tuning and tone. A picture of the set in its cabinet is shown on page 73.

THE NEW FIRESIDE FIVE

One of our best and steadiest "sellers" over many years has been the Fireside Five. We thought it appropriate to start the New Year with a modernised version which retains the easy-to-make features of the original. The cabinetmaker has come up with a neat, well-balanced design which makes our new set attractive to look at as well as to hear.

THIS may not be quite the correct time of the year to be discussing a "fireside" set but, although the name does stem from a natural desire for personal comfort on cold winter evenings, our new set will appeal to you as a "snappy" little job whatever the season.

The original Fireside Five was described in August and September, 1946. It appeared in two versions, B/C and D/W, and proved very popular. It offered few difficulties to the average home constructor and could perform as well as any table mantel set.

POPULAR SET

In recent discussions with cabinet manufacturers, we found that the cabinet originally used with that set was still in demand, indicating that this type of receiver is still as popular as ever.

The probable reason is that while small sets like the Little General have a great following, the extra valve in the larger table mantel gives extra sensitivity and greater lattitude in the possible use of a pick-up. The larger speaker and cabinet, too, give decidedly better tone than is possible with the smaller sets.

In the light of this, we set out to "modernise" the original Fireside Five with miniature valves on a more compact chassis, a modern high-flux density speaker and a somewhat neater cabinet in two-tone styling set off with plastic piping. The final product is pictured on these pages.

We expect this new set to be even more popular than its predecessor of 1946 and have placed emphasis on general simplicity and ease of construction.

by Raymond Howe

Although no wiring diagram is given, the coded underchassis photograph will keep you on the right track.

Most of this article will be devoted to constructional matters, but first of all, here is a brief outline of the circuit design.

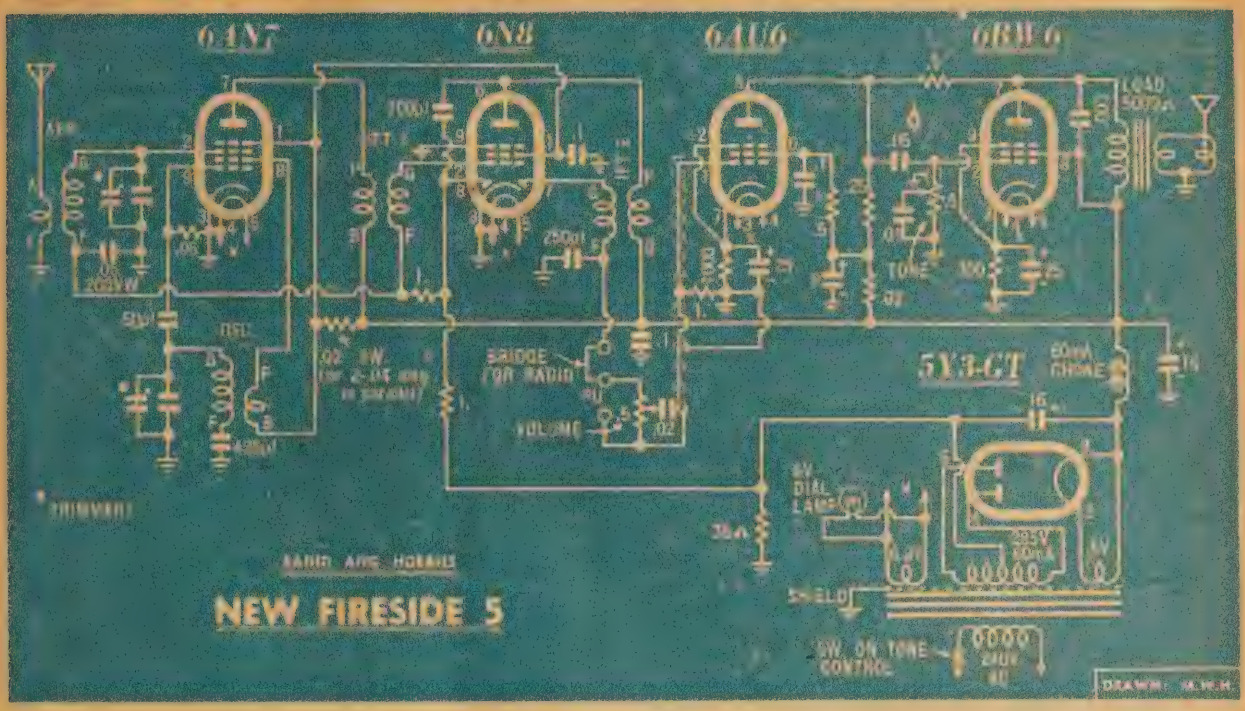
MINIATURE CONVERTER

A 9-pin miniature converter, the 6AN7, is used in the first stage. The miniature 6AE8 could be used equally as well, the only change necessary being in the pin connections.

Components in this stage are kept to a minimum by earthing the 6AN7 cathode, biasing it at minus 2 volts via the AVC line, and feeding the oscillator anode and the converter screen from a common dropping resistor at about 80 volts "no signal".

The IF amplifier stage uses a 6N8. This stage also has the cathode earthed, and derives its standing bias through the AVC line. The screen is taken to the common 80 volt point in the converter stage.

CIRCUIT DIAGRAM RETAINS ORIGINAL SIMPLICITY



Study this circuit diagram in conjunction with the coded underchassis photograph and you should not have any worries with the wiring of the set. The text of the article should clarify any points which may emerge. Note the shielding of the leads to each control and the earthing of the shield braid at the respective sockets.

You will note that the volume control, which is actually the diode load impedance, is connected to the diode circuit through a pair of bridged terminals. When the bridge is removed from the terminals, a crystal pick-up can be fed into the volume control and hence through the audio end of the set.

The first audio valve is a 6AU6 miniature pentode. We purposely used a high gain valve so that we could introduce a reasonable amount of negative feedback between the anode of this stage and that of the output stage. The actual feedback is about 14 db.

The output valve is a 6BW6, which has electrical characteristics similar to those of the octal-based 6V6GT. There is no need for a higher-Gm power valve.

AUDIO OUTPUT

The 6BW6 is slightly overbiased to keep the total current drain to just below 60 mA but, nevertheless, it is capable of over 3 watts of audio power output. This is quite sufficient for a set of this nature.

The chassis is of new design. The old chassis design just would not do. This one is much smaller and measures 11-7/8in by 6½in by 1¾in.

For the smaller cabinet, a relatively small dial was necessary to give a logical balance between the cut-out, knobs and speaker fret. We selected the SLV/21, a vertical straight line type.

Some modification to the dial was needed so that three controls could be balanced with respect to the dial escutcheon. This involved drilling out to 3/8in the two slotted 1/8in holes at 1¾in either side of the centre hole. The cord drive spindle is mounted in the centre hole after slotting it.

The lower cord guide pulley will need to be shifted inward to the threaded hole about ¼in away so that it will not be fouled by the tone control. The cord will pass close to the back of the bottom strap holding the dial glass, but there is sufficient clearance unless this strap happens to be bent.

Admittedly, there's not much involved in mounting the major components on the chassis, but for the purposes of discussion let's start with the power transormer and filter choke. As shown in the underchassis photograph, the filter choke mounts on the underside near the power transformer.

Mount the tuning gang in position with the feet on that side of the frame end plates which allows the moving plates to open upward. The dial could now go into position. It is held in place by the

PARTS LIST

- 1 chassis 11.7/8in X 6½in X 1¾in and cabinet to suit.
- 1 power transformer 285V a side 60 mA, 6.3V 2A, 5V 2A.
- 1 60 mA filter choke.
- 1 6 inch speaker complete with 5000 ohm transformer.
- 1 miniature 2-section tuning gang, 2 gang section trimming capacitors.
- 1 dial with glass to suit gang (SLV/21)
- 1 broadcast aerial coil, 1 broadcast oscillator coil (suit 6AN7).
- 2 standard 455 Kc IF transformers.

VALVES

- 1 6AN7, 1 6N8, 1 6AU6, 1 6BW6, 1 5Y3GT.

CAPACITORS

- 2 25 mfd 40PV electrolytics, 2 16 mfd 525PV electros., 1 8 mfd 525PV electro., 3 .1 mfd, 1 .05 mfd, 1 .05 mfd 200VW 1 .42 mfd, 1 .01 mfd, 1 .005 mfd 1 425 pf (low tolerance), 1 250 pf, 1 100 pf, 1 50 pf.

RESISTORS

- 3 1 meg. ½w., 2 .5 meg. 1w., 2 .5 meg. potentiometers, (one with switch attached), 1 .25 meg. 1w., 1 .05 meg. ½w., 1 .02 meg. 2w. (or 2 .04 meg. 1w. in parallel), 1 .02 meg. ½w., 1 1000 ohm ½w., 1 300 ohm 1w., 1 35 ohm ½w.

SUNDRIES

- 3 knobs (medium size). 3 terminals (2 red, 1 black), 1 6V dial lamp, 3-core power flex and 3-pin plug, 1 5-tag, 2 3-tag and 1 2-tag mounting strips, approx. 2 ft. shielded hook-up wire, spaghetti (two sizes), rubber grommet for power trans, leads and power flex entry, hook-up wire, solder, lugs, nuts, bolts.

You can easily change Worn Needle Styli yourself!

PICKUP IDENTIFICATION

★ For Standard "78" Records only:

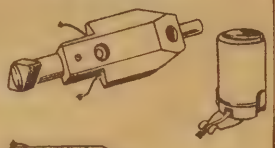
Group A:
Magnetic and crystal pickups using needle screws.

★ For Standard "78" and L.P. Records:

Group B:
Light weight pickups using miniature needles of push-in type.

Group C:
High fidelity pickups with styli as integral part of their construction.

Group D:
Crystal and magnetic cartridges using push-in cantilever styli.



Group E:
Crystal cartridges with screw-in cantilever styli.

● *All styli are available* for standard marked *Green*, for L.P. (Microgroove) marked *Red*. *The only exception is the No. 150 stylus*, where standard is marked *Blue*.

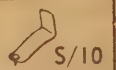
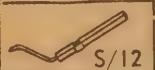
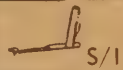
- **Prevent Record Wear . . . Enjoy Better Reproduction and Less Surface Noise!**
- **REPLACE STYLI regularly with the correct GOLDRING Replacement.**

Goldring

A good quality sapphire needle stylus, as incorporated in the equipment of reputable manufacturers, should survive many hundreds of playings for standard records, and at least one hundred playings for LP records before wear causes damage to records and inferior reproduction.
But such life expectancy can be substantially reduced. Faulty, chipped or dust-laden records can have disastrous results. The weight, damping and tracking of your pick-up affect the rate of wear. And, most important, the method of handling (gentle or otherwise) either manually or by the record changer.
Safeguard your valuable records . . . the cost of regular stylus replacement is negligible in comparison.
DANGER SIGNALS
Standard Records. Black dust accumulating on needle point and increased surface noise.
LP Records. Fine thread or fluff at needle point and discolouration of grooves.
You can easily change the needle stylus yourself. Read the identification details and fitting instructions. All leading retailers stock "Goldring" replacement styli.

NEEDLE IDENTIFICATION

Check for detail only . . . needles are NOT shown in actual size.

GROUP			
A	S/1	S/6	S/1 is recommended for light crystal pickups. S/6 for record changers and both crystal and magnetic pickups, minimising record wear.
B	S/3	150	S/3 for Connoisseur, Goldring 121, 122, H.M.V. and other light weight pickups. 150 for Goldring 3-way pickup. *Blue* stylus for Standard. *Red* for L.P.
C	★ Styli, being an integral part of pickups in this group, cannot be supplied. New styli will be fitted at moderate cost by Goldring Service Department, 57 H.E. Area, *ST. MARYS, N.S.W.* Please take cartridge to your retailer, who will make necessary arrangements. The best known pickups in this group are the *Goldring Headmaster* and the *Decca magnetic* pickup. In the case of the latter it will be sufficient for armature to be sent in to effect styli replacement.		
D	S/8	S/9	S/8 for BSR. record changer. S/9 for various Acos cartridges. The main difference between S/8 and S/9 is length and angle. As the angle cannot be re-set watch this point carefully. S/9 used by Collaro, Garrard, Acos and others. S/10 for Goldring Magna cartridge No. 200. S/11 for Plessey Changer. S/12 Garrard "Astatic" U.K. S/13 Garrard "Astatic" U.S.
	 S/10	S/11	
	 S/12	 S/13	
E	S/7		S/7 used in *Goldring turnover* pickup, *BSR. unit* GU-4, *Stromberg-Carlson* changer, *Garrard* changer, *Acos* pickup, etc.

You can easily change styli yourself. A small screwdriver and a small pair of flat pliers are the only tools required.
First identify the PICK-UP GROUP from chart above; then further check against the STYLUS REFERENCE CHART at left.

FITTING INSTRUCTIONS

GROUP A: No tools required.
GROUP B: Styli to be inserted without side pull or bending. It is important for needle point to be perfectly straight over record.
GROUP C: Styli replacement by Goldring Service Dept.
GROUP D: Withdraw old needle styli by gentle but straight pull and insert new styli without using force in the same manner. Using force would damage pick-up mechanism as well as possibly snap off cantilever of stylus. If cartridge is inaccessible for effecting styli change while cartridge is in position, it can easily be removed in all cases by unscrewing cartridge from pick-up arm.
GROUP E: Turn cartridge until styli holding screw in centre of cartridge shows. By unscrewing it, both styli can be withdrawn simultaneously and new styli inserted, making sure the flats of these go inside.

GOLDRING ENGINEERING (Australasia Pty. Ltd.)
57 H.E. AREA, ST. MARYS, N.S.W.

tone and volume control potentiometers.

During fitment, the dial drive drum should be removed from the dial back plate and "floated" on the tuning gang spindle. This is the correct method as it eliminates stress being placed on the gang bearings.

At this stage it would be wise to fit the chassis into the cabinet so that the control shafts can be cut to the correct length. A ready-made cabinet would normally have the dial cut-out and knob holes already arranged for you, but if you are faced with this job, here is a simple way of going about it.

Place a daub of paint, ink or boot polish, &c., on the end of the shafts, slide the chassis into the cabinet and, when correctly positioned, gently press it against the inside front. On removal, the position of the knob holes will be readily seen.

After drilling the holes, position the chassis so that the dial glass is just clear of the inside of the cabinet and mark the length of shaft required for the controls. Remove the set, take the controls out one by one and cut the shaft. You could cut the dial spindle in situ, with the aid of a vice.

CONTROL MOUNTING

A reasonable amount of clearance should be given for the control holes, particularly for the dial drive spindle. Of course, the holes will not normally be visible when the knobs are in place.

When the controls are mounted again and tightened, the lugs of the tone control should be toward the dial spindle and the lugs of the volume control toward the speaker position.

There is a little leeway in the vertical position of the dial glass. It should be set so that the escutcheon and the knobs balance with the speaker fret. Having decided on its position, the measurements can be transferred to the cabinet front and the cut-out made.

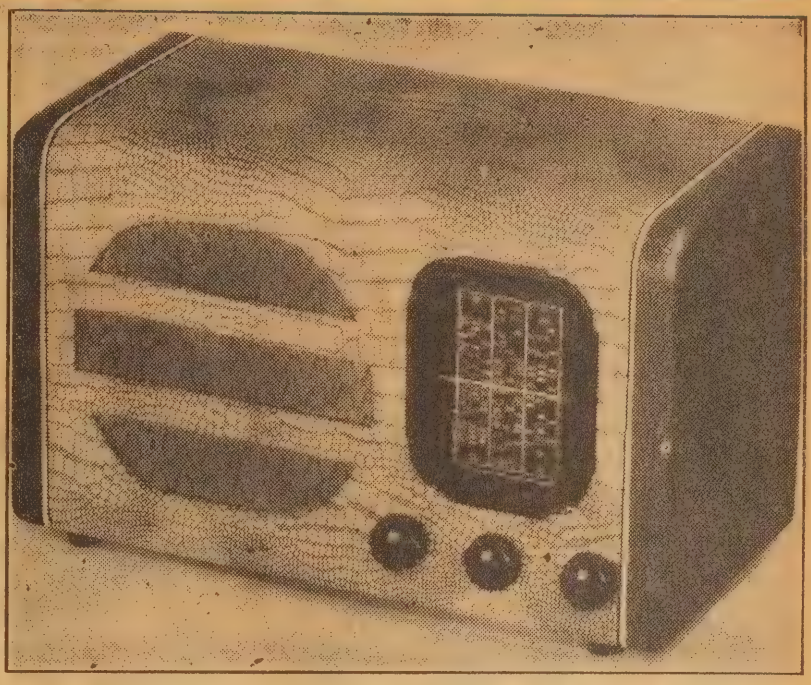
Incidentally, it is intended that the space between the speaker facing ring and the inside of the cabinet front be filled with a small 3-ply baffle and a piece of corrugated cardboard. The cardboard will take in irregularities of the chassis front and speaker rim.

VALVE SOCKETS

Getting back to the chassis work, the next step would be to fit the valve sockets. It is important that some logical orientation be given to them as it leads to better placement of minor components and wiring. To save you the trouble of deciding which way to put them, we have marked their orientation on the underchassis photograph.

Look for the straight arrows near each valve socket. In the case of the 7-pin and 9-pin miniature sockets, the arrow indicates the position of the gap between pins 1 and 7 and 1 and 9 respectively. At the rectifier socket, it indicates the position of the keyway in the centre of the spigot hole.

Similarly, the orientation of the coils and IF transformers is shown on the underchassis photograph. The letter G is marked alongside the grid pin in each case.

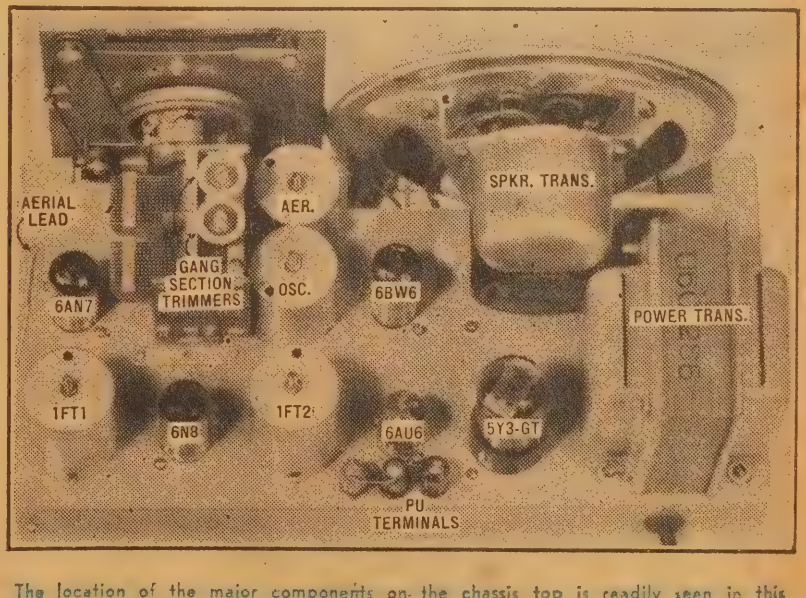


Here is the new Fireside 5 housed in its attractive two-tone leatherette-covered cabinet with contrasting plastic piping. The cabinet is open at the rear for purposes of ventilation.

During the mounting of these components, place solder lugs under the both nuts of all 9-pin valve sockets, the aerial coil and IFT1 and under the inside nut of IFT2 and the power transformer.

The position of tag-mounting strips are marked with an asterisk on the underchassis photograph. That under the rear nut of the 6N8 socket is a 3-tag, that near the 6BW6 socket is also a 3-tag, while that under the rear inside nut of the power transformer is a 5-tag.

All that now remains is to insert the three terminals along the rear edge and to mount the speaker in place. When purchasing the speaker, obtain one complete with the speaker transformer mounted on its bracket. The type we used has also a mounting bracket fitted for attachment to the chassis top.



The location of the major components on the chassis top is readily seen in this view. Note how the aerial lead is taken through the chassis ahead of the 6AN7 and passed to the rear along the side.

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1332-3H	200-220-230-240	300	120	2 x 6.3v-2A; 5v-3A	53/3
1356-3H	200-220-230-240	400	150	5v-3A; 2.5v-5A; 6.3v-4A	70/-
1371-8	200-220-230-240	500-600-750 850-1000	300		150/-
1400-19	200-220-230-240	565-500-425	250	2 x 6.3v-3A; 2 x 2.5v-3A; 5b-3A	110/-
1643-23	200 or 230	—	—	6.3v TAP 5v-2A (500v insul)	17/6
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973-21	30	20	80	370	500	25/9
1012-1A	35	20	120	430	1000	35/3
967-1A	35	20	150	200	1000	46/-
956-1A	30	20	200	160	1000	57/9
1011-1A	30	15	250	160	1000	59/6
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Bolting this bracket to the chassis will actually provide sufficient support. The ready-made chassis will also have a couple of holes in the front face to take two bolts through the speake outer frame. If you feel that you want to secure the speaker at the front face as well as with the attached bracket, see that the speaker frame is not distorted by misalignment of the bracket with the chassis.

We used the inside front mounting bolt of the speaker to secure a 2-tag mounting strip near the volume control. This carries the .02 mfd coupling capacitor to this control.

You are now in the position to start the wiring.

We always recommend that at the first step you connect all of the solder lugs together with a run of light gauge tinned copper wire. This provides an earthing "mat" which tends to obviate any trouble which may arise from a single faulty earth point to the chassis.

TRANSFORMER CONNECTION

Now trim the power transformer leads and lay them in place, taking the primary winding leads to two insulated lugs of the 5-tag strip near the rectifier socket. Earth the centre spigot of all miniature valve sockets and connect to the spigot those socket pins shown on the circuit diagram as being earthed.

Lay in the straight wiring runs between sockets, IF transformers, coils and tuning gang. You can pick these out on the circuit diagram. Note that one side of the 6.3 volt wiring is earthed at both the 6AN7 and 6N8 sockets. In most cases, earthing at one socket only would be satisfactory. The double earthing is merely a precautionary measure. Make sure that you earth the same side of the winding at each socket otherwise you may short out the winding.

The minor components follow. You can start at either "end" of the circuit, going through stage by stage. This is where you find the coded underchassis photograph helpful. Study it in conjunction with the circuit diagram and you should not have any trouble in "seeing" where the pigtails of each component connect.

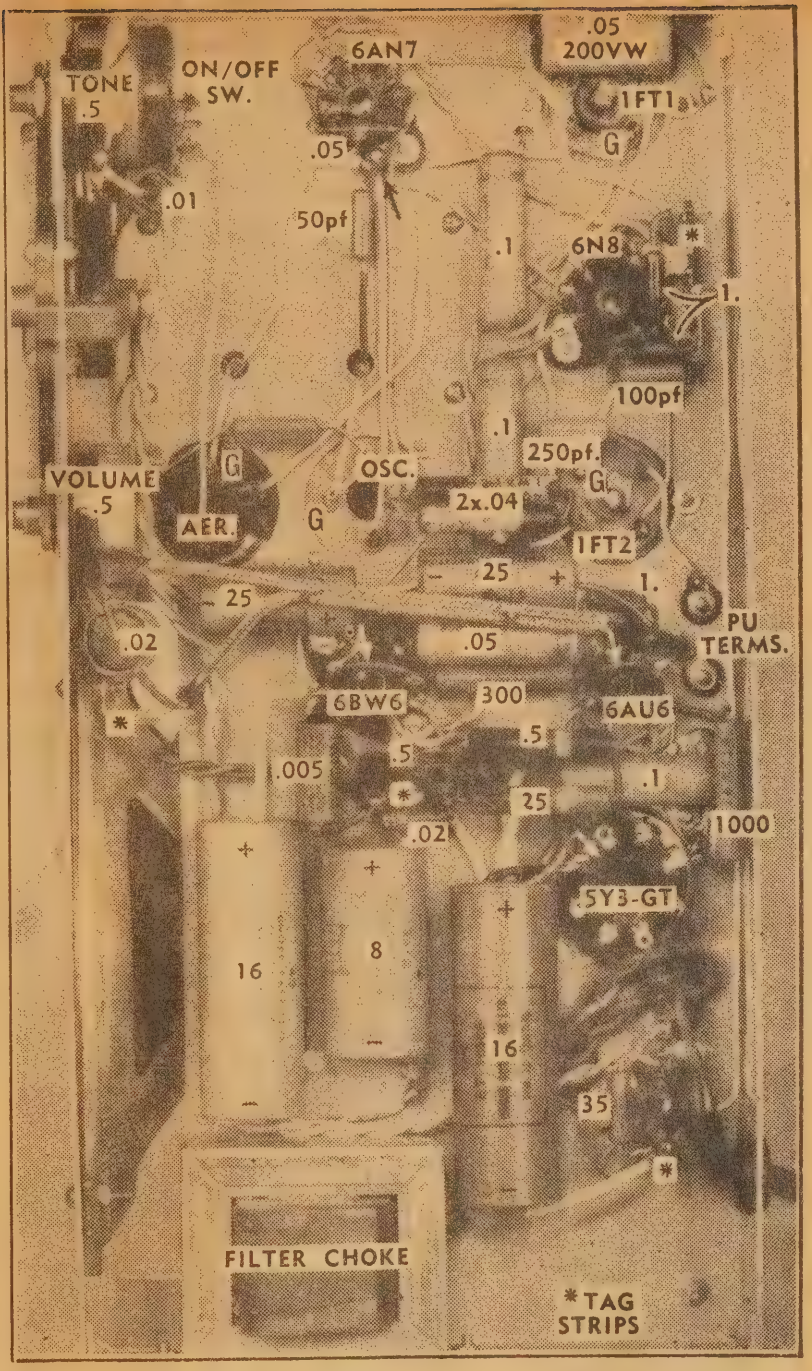
SMALL COMPONENTS

The 3-tag mounting strip at the 6N8 socket carries the "cold" end of the 1 megohm resistor in the AVC circuit. The other end of the resistors connect to pin 8 of that socket. Use ½ watt resistors here, trim the lead on the socket end of each resistor reasonably short and keep the body of these resistors toward the rear side of the socket away from grid pin 2. This prevents coupling across the stage which could lead to instability.

The .02 megohm 2 watt (or two .04 megohm 1 watt in parallel) bridges across from the "B" pin of IFT2 to the "B" pin of the oscillator coil. Leave the pigtail leads sufficiently long to keep the resistors away from the nearby capacitors.

The .1 mfd capacitor situated between the 6AN7 and 6N8 sockets is the common screen bypass for the first two stages. For preference it is wired from the screen of the 6N8 to chassis as shown in the circuit diagram.

The .1 mfd capacitor in line with it is the high tension line bypass. Again for preference it is wired between the "B" pin of the IFT2 and chassis.



This photograph will give you sufficient information to enable you to duplicate the original. Suggested orientation of the valve sockets, coils and IF transformers is shown. Tag strip positions are marked with an asterisk.

The screen bypass capacitor for the 6AU6 lies between that socket and the rectifier socket with the 1000 ohm cathode resistor across one end of it. Although a 1 watt resistor is shown here in the photograph, use the ½ watt size.

The 25 mfd cathode bypass of the 6AU6, the .1 mfd interstage coupling capacitor and the 6BW6 cathode resistor lay in between the 6AU6 and 6BW6 sockets.

The 3-tag mounting strip near the decoupling resistor to the 6AU6. This 6BW6 socket mounts the .02 megohm means that one lug carries the junction of the plate and screen resistors, the 8 mfd electrolytic and the .02 megohm resistor. The other lug is a high tension point and carries one side of the 6BW6 .005 mfd plate bypass.

Don't forget when laying in the 16 mfd electrolytics that the earth end of the one immediately following the rectifier connects to an insulated lug on the 5-tag strip. The power transformer centre-tap also connects to this point and the 35 ohm backbias resistor bridges from this point to the earth lug of the strip.

Incidentally, if you have trouble in obtaining a 35 ohm resistor, two 75 ohm resistors connected in parallel will be close enough in value.

The lead to the .5 megohm tone

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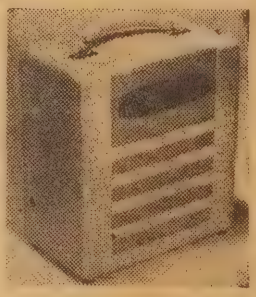

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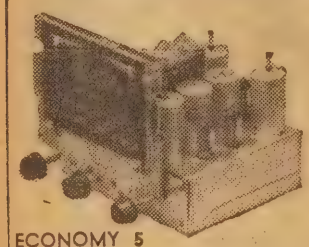

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control is run in shielded hook-up wire. Take it under and around the control connecting the braid to the first lug encountered and the inner lead to the lug on the other side. The .01 mfd capacitor is mounted at the control between the centre lug and the earth side.

A length of spaghetti is slipped over the shielded wire so that the shield braid touches the chassis at the 6BW6 socket only. This is merely a precaution against hum injection into the 6BW6 grid circuit from chassis eddy currents.

The shielded leads to the volume control are taken in a "free space" run direct from the centre terminal and pin 1 of the 6AU6 socket. Connect the lower lug to the braid and earth the braid at one point only near the 6AU6 socket for the same reason as with the tone control.

Connect two leads from the switch on the tone control to one side of the power transformer primary and to a free lug on the 5-tag strip. The incoming mains flex connects to the other side of the transformer primary and to the free lug. This places the switch in series with one of the main leads.

GANG TRIMMERS

Keep the switch leads away from the volume control connections and the .02 mfd capacitor to avoid hum induction.

Use 3-core flex for the mains lead, connecting the green-colored earth lead to the earth lug of the 5-tag strip. This earths the set via the power mains earth system.

Finally, fit the trimmers across each section of the tuning gang and take a lead from the aerial pin of the aerial coil out through a hole in front of the 6AN7 and along the side of the chassis. This keeps it away from the IF stage wiring where it could introduce instability.

When fitting the trimmers, make sure that the top plate of each is the one which connects to the frame of the gang. We held a solder lug under a bolt slipped through one of the holes in the top of the gang frame and soldered the earth side of the trimmers to this.

One side of the voice coil winding of the speaker transformer is shown in the circuit diagram as being earthed. This is merely another precautionary measure and is not normally necessary in circumstances such as this.

TESTING

The set is now ready for testing and alignment. Plug in all valves except the rectifier and see that the heaters light. Plug in the rectifier and watch through the top of its glass envelope for any indication of a steady blue glow. A momentary blue glow is not suspicious but if it persists, the set should be switched off immediately and a check made for a short circuit in the high tension circuit. Also make sure that the electrolytic capacitors are connected in the correct polarity.

Assuming that all is in order, go ahead with the alignment procedure. See that the dial glass is positioned correctly and that the dial pointer has equal overlap on the dial at the extremities of the travel of the gang moving plates.

If you have the facilities of a service oscillator, align the If transformers to 455Kc and then adjust the

(Continued on Page 112)

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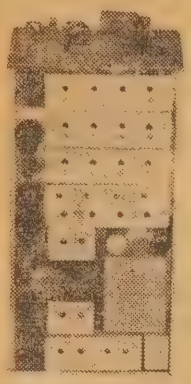

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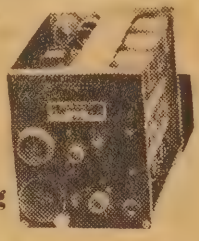

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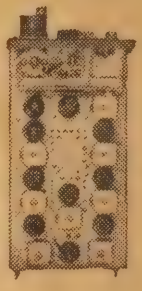

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GARRARD OR B.S.R. THREE SPEED MOTOR (33, 45, and 78) WITH SINGLE KNOB CONTROL AND ACOS GP30 PICK-UP. TURN-OVER CRYSTAL HEAD.

Supplied in veneered and polished or leather-covered case. Leatherette case has space for amplifier if required.

£12/15/-

F.O.R.

METROPOLITAN RADIO SUPPLIES

479 Parramatta Rd., Leichhardt, NSW.

(At top of Taverner's Hill)

PHONE LM3610

NEW — SPEAKERS — AT — HALF — PRICE

Special purchase of 1000 new Permagnetic speakers made by one of Australia's leading manufacturers enables us to sell these units at half price.

8in. SPEAKERS
HEAVY-DUTY PERMAGNETIC WITH 20,000 OHM C.T. TRANSFORMER **34/-**

6in. SPEAKERS
HEAVY-DUTY PERMAGNETIC WITH 15,000 OHM TRANSFORMER **29/-**

POSTAGE and PACKING

	NSW	Interstate
12in SPEAKERS	7/6	12/6
8in SPEAKERS	5/6	9/6
6in SPEAKERS	5/-	8/6
TRANFORMERS	1/6	

12in SPEAKERS
HEAVY-DUTY PERMAGNETIC WITH 5000 OR 10,000 C. T TRANSFORMER .. ..
WITH 15,000 OR 20,000 TRANSFORMER .. 50/-
Separate Transformers to suit any of above speakers—5000 ohm. 8/6 each (Supplied with speakers only.) **54/-**

NEW — DYNAMIC — SPEAKERS

New 7in dynamic speaker by leading manufacturer 1500 ohm field coil, 7000 ohm transformer -- -- **27/6** (SPECIAL PRICE FOR QUANTITY)

Postage N.S.W. 3/6. Interstate 5/6.

NEW VALVES IN CARTONS
SPECIALS (Ex-Disposals)

12SH7 .. .. 7/6	6U7G 12/6	6SH7 .. .. ..7/6
12A6 .. .. 12/6	6SA7GT .. 12/6	EF50 .. .. 11/6
12SL7 .. .. 12/6	6SK7GT .. 12/6	7195 .. .. .. 5/-
12SJ7 .. .. 12/6	6SQ7GT .. 12/6	EF50 with
12SK7 .. .. 12/6	3S4 .. .. .. 15/-	socket .. 11/6
9001 .. .. .. 10/-	6C4 .. .. 15/-	6H7 or 1K5 5/-
9004 .. .. .. 10/-	6AG5 .. .. 15/-	in dozen lot.
AV11 .. .. 9/9	1S5 .. .. .. 15/-	6J8G 17/6
1K7G 9/6	1T4 .. .. .. 15/-	6AC7 .. .. 12/6
1M5G 9/6	VR65A 3/6	955 (acorn) 12/6
1C7G 11/6	1Q5GT .. 12/6	957 (acorn) 10/-
1L5G 10/6	5Z3 .. .. ..15/-	6AK5 .. .. 15/-
6K7G 8/6	1K5 .. .. ..7/6	1P5 .. .. .. 12/6

Please add postage

New Electrolitic Condensers

8 MFD-525V **3/6** each or **34/-** dozen plus post.
8 MFD-350V **2/6** each or **24/-** dozen plus post.
4 MFD-600V **2/6** each or **24/-** dozen plus post.
16 MFD-350V **3/-** each or **30/-** dozen plus post.
12 MFD-600V **4/9** each or **48/-** doz. plus post.

New Paper Condensers

.25-400v .. .. 5/6 per dozen	.02-600v .. .. 4/6 per dozen
.10-400v .. .. 3/9 per dozen	.005-600v .. .. 3/9 per dozen
.05-200v .. .. 3/6 per dozen	Mixed mica cond. 3/9 dozen

POSTAGE EXTRA

NEW COILS AND INTERMEDIATE TRANS, BY A LEADING MANUFACTURER

Permatune I.F. trans. 455K.C. -- -- -- -- **9/6**
Aer Permatune B.C. coils 455K.C. -- -- **7/6**
R.F. Permatune B.C. coils 455K.C. -- -- **7/6**
Osc. Permatune B.C. coils 455K.C. -- -- **7/6**
Aer. Permatune S.W. coils 16-50M. -- -- **6/6**
R.F. Permatune S.W. coils 16-50M. -- -- **6/6**
Osc. Permatune S.W. coils 16-50M. -- -- **6/6**

METROPOLITAN RADIO SUPPLIES

479 Parramatta Rd., Leichhardt, N.S.W.
(At top of Taverner's Hill)
PHONE LM3610

NEW VALVE SOCKETS

Teleton 8-pin octal moulded sockets **5/-** per dozen or **25/-** per 100.

American 8-pin Loctal high insulation **5/-** per dozen or **25/-** per 100.

CARBON RESISTORS

Well - known make of carbon resistors in values of 100 ohms to 5 megohms. In 1-watt, ½-watt and 1/3 watt. All resistors are standard color coded and in original cartons. In lots of 100 mixed values comprising 50 1-watt, 25 ½-watt, 25 1/3-watt. .. Post, 1/6. **12/6**
IN LOTS OF 500, 50/-.

SOLDER

English multi-core solder in 1 lb reels.
12/6 per lb.
Postage Extra

NEW-SWITCH POTS

Standard - switch potentiometers—½-meg or 1-meg.
6/6
Plus postage.

TRICKLE-CHARGER KITS

Kits for trickle-charger as described in R. & H., June issue. Comprising transformer with 18V winding tapped at 12V-3 100mA rectifiers and 50 ohms control. **39/6** Postage NSW. 5/-; Interstate, 7/6.

TRANSFORMER SPECIAL

H.D. Power Transformer 265 x 265
250mA 4v Fil. Windings **£2/5/-**
H.D. Power Transformer 365 x 365
150mA 4v Fil. Windings **£2/5/-**
C.R.O. Transformer 1540v, 2v
Filament Winding **£2/5/-**
150mA Filter Choke **£1/2/6** Prices F.O.R.

NYLEX HOOK-UP WIRE AT HALF PRICE

Nylex hook-up wire 10/- .010 in 100 yard coils, each coil consisting of five 20 yard lengths in 5 different colours.
10/- PER 100 YDS. Plus postage

AMERICAN RELAYS

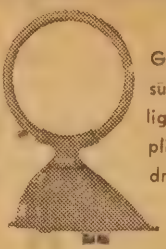
No. 1 Miniature relay 300 ohm coil, S.P.D.T.: contacts, 7/6

No. 2 Standard relay 250 x 250 ohm coil 4 pole S.T. 7/6
2 pole S.T. 6/6

No. 3 Standard relay 15,000 ohm coil, 2 pole D.T. .. 12/6

All relays suitable for rewinding.

MN26 COMPASS LOOPS



Geared rotatable loop suitable for adapting to light beam rotators supplied with 30in flexible drive.

37/6 plus postage.

CONDENSER SPECIAL

American Dubilier oil filled paper condensers. 15MFD.—600 Volt.

12/6 plus postage

3 SPEED RECORD CHANGERS

NEW THREE SPEED RECORD CHANGERS: INCLUDING COLLARO, GARRARD, STROMBERG-CARLSON and PLESSEY.

These changers are new but are shop soiled.

ALL ONE PRICE

£14/10/'

F.O.R.

(Country clients please indicate second choice)

HIGH-POWER I.R.C. RHEOSTATS

250 ohm, 25 watt.

10 ohm, 2½ amp; 25 ohm, 1 amp Price, each 10/6

50-CYCLE A.C. AMMETERS

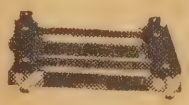
Range 0-14 Amps. Scale Size 4in. Dia. Brand New.

Price, each,

45/-

Packing and postage: NSW, 3/-; Interstate, 5/6.

SHOCK MOUNTS. NEW!



Protect your equipment with these mounts. Set of 4 mounts and rack, 11 inches by 8 inches

5/6 plus postage

CONDENSER SPECIAL

New Midget Variable Condensers, 19-plate ceramic insulation. PRICE 5/6

Packing and Postage: NSW, 1/-; Q., T. and V., 1/6; WA, NT, 2/-.

D.C. GENERATORS

12v 750 watt. Ideal Homelighting, Battery charging, etc.

PRICE £4/10/- F.O.R.

SANGAMO PRECISION TIMERS

48-hour jewelled movement. Can be run continuously or for one minute periods. Ideal for photographers, hobbyists, electrical flashes, signs, etc. 22/6

Packing and Postage: NSW, 2/-; Interstate, 3/6.

AERIAL RELAYS

Aerial changeover relays in metal case (24v). 18/6

Plus Postage.

1143A. TRANSCEIVERS

(English equivalent to scr. 522)

Frequency range 100 to 156 m/cs. Complete with 20 6.3V Valves. New condition, supplied in transport case.

£12/15/- plus postage

SCR 522 TRANSCEIVERS

Freq range 100 to 156 m/cs complete with valves £24/10/-

Genemotors for above input 28V with filter £2/15/-

TYPE 1133 TRANSCEIVER

Freq. range 90 to 130 m/cs contains 17 6.3 volt valves £8/17/6

A.T.5-A.R.8 POWER SUPPLY

24 volt genemotors supply containing two genemotors one giving 550 volt at 350 mills and the other 250 volt at 100 mills, also contains filter condensers, relays, fuse holders etc.

£4/10/-

ALL ABOVE PRICES F.O.R.

METROPOLITAN RADIO SUPPLIES

479 Parramatta Road, Leichhardt, N.S.W.

at top of Taverner's Hill

PHONE LM 3610

SHIELDED PLUGS AND SOCKETS

4 pin as illustrated. Quantity available.

Price, each .. 4/6 Per Doz. .. 45/-

Packing and Postage: 6d each. Per doz., NSW, 1/6; Q., T., V., 2/6; NT, SA, WA, 3/6.

NEW MN26 COMPASS CONTROL-BOX

37/6

6in Flexible drive for above, 10/-. 24in, 18/6.

Postage extra.

SPECIALS

Dynamic Mike Inserts	6/-
Carbon Mike Inserts	2/6
Bakelite Fuse Boxes	4/6
5-Position Push Button Switches	10/6
Carbon Mike Trans.	4/6
Double Button Carbon Mikes	7/6
Throat Mikes	5/-
Cutler Hammer Switches	2/6
P.M.G. Key Switches, 32 contact	8/6
Shielded Hook-up Wire, yard ..	8d
3 gang Standard Condenser ..	20/-
Twin Co-ax Cable, 20ft lengths	6/-
2 gang Condenser	16/-

NEW WESTON & FERRANTI METERS

0—.5 amp. RF thermacouple	9/6
0—3 amp. RF thermacouple	9/6
0—4 amp. RF thermacouple	9/6
0—10mA DC	17/6
0—20 volt DC	17/6
0—5 amp. DC	27/6
0—10 amp. DC	27/6

(All above are 2in flush mount.)

0-10mA DC English Turner 3in Round Flush Mounting 30/-

Postage Extra.

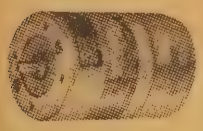
NEW -- AMERICAN TELEPHONE WIRE

Rubber insulation with stainless steel and copper conductors supplied on metal reels each containing half mile of wire. £1/15/- per reel
In case lots, each case containing six reels (three miles of wire) £10 PER CASE F.O.R.

NEW---AERIAL WIRE

Suitable for indoor or outdoor aerials, also suitable for bell wiring, etc. Supplied in fifty or hundred ft. coils. 50ft 2/- 100ft 3/6

A MOTOR WITH MANY USES



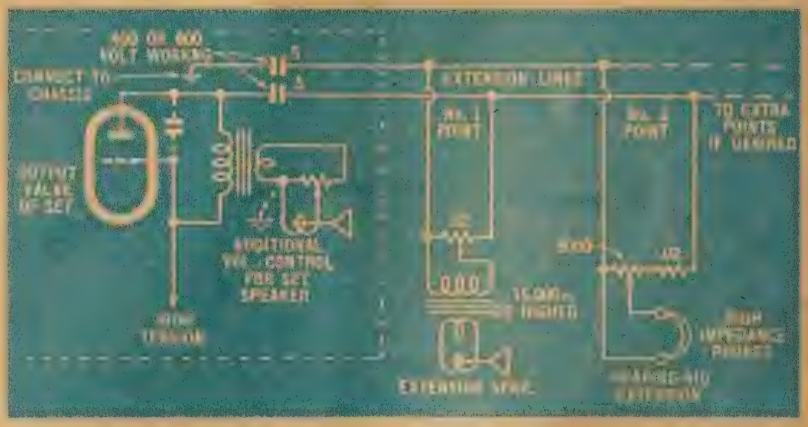
Small 24-volt motor suitable for AC or DC, reversible operation, fully laminated. Approx. one-fifteenth H.P. Size 3¾in x 2½in. ¼in Spindle. Mounting bracket supplied -- -- --

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

RADIO EXTENSION POINT AS AID TO HEARING

Here is one way of providing satisfactory radio listening facilities for those who are "hard of hearing," whilst retaining the comfort of other members of the household. Fitted to a conventional radio set, it can provide a number of points, including loudspeaker extensions.



OUR contributor is Mr. J. E. Healey, C/o Mettur Industries Ltd., Mettur Dam R.S., Salem DT, South India. He rightly points out that the effectiveness of the arrangement depends upon the type of deafness involved. The person with whom he was concerned was a "bone conduction case" and it is reasonable to assume that the form of aid shown here will be of assistance to quite a number of people.

Program output from the domestic radio set is taken from between the anode of the output valve and chassis and run to desired points in the house through extension lines. The .5 mfd are DC-blocking capacitors and should, in the interests of safety, be of 400 or 600 volt-working rating. The .5 mfd in the earthy side of the line is a wise precaution, particularly with a set operating from DC mains.

At each selected point, some form of junction box is arranged to connect either an extension speaker or a pair of headphones. The method of fitting the extension line components into the system can suit the individual.

Although the series resistor at the headphone extension is shown as .02 megohm, it should be selected by experiment to give a suitable range of volume control with the 5000 potentiometer consistent with the requirements of the individual, the sensitivity of the phones and the output of the radio.

At the speaker extension, the impedance of the transformer is not critical, some value around 15,000 ohms being satisfactory. Too low a value will shunt the load impedance of the output valve and reduce output capabilities, although in some cases this may still be quite in order.

The .02 megohm potentiometer is also open to variation but the same

(Continued on Page 107)

HT SUPPLY FOR BATTERY SET

Here is how a country reader used some disposal items to provide high tension supply to his battery set on what approaches a "fit and forget" basis. He claims almost three years of satisfactory operation, for an initial cost of less than one set of heavy-duty day batteries.

THE idea is submitted by Mr. W. R. Jasper, of Kanagulk PO, Victoria. His set used 2 volt valves operating on 135 volts of high tension. To replace the dry battery supply, he purchased the LP unit of a disposals No. 11 set and replaced the 12 volt genemotor with a smaller one rated at 260 volts output for 28 volts input.

The LT side of the genemotor is fed from a 32 volt lighting plant through a 25 watt 32 volt lamp and the 2 volt "A" battery of the set. To ensure that the set filaments come on at the same time as the genemotor, one side of the "A" battery feed to the set is passed through one pole of a double-pole switch, the other pole switching the LT side of the genemotor.

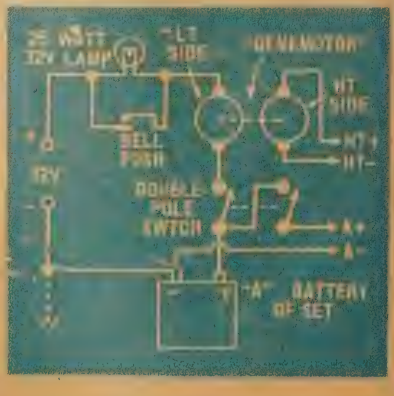
To obtain sufficient starting current for the genemotor, a simple bell-push is wired across the series lamp. A momentary touch of this bell-push is sufficient. It should not be held down. Mr. Jasper obtained an output of about 150 volts.

The current drain on the 32 volt source is approximately half an empere and as this is passed through the "A" battery, it lengthens considerably the time between periodic charges.

Our contributor says that the existing filter components in the disposal genemotor supply give an entirely smooth output. He mentions that voltage-drop in some 32 volt wiring may require the use of a 40 watt 32 volt lamp instead of the 25 watt shown.

He also mentions that a friend who has a 12 volt lighting system used the same idea but retained the 12 volt genemotor. It would still require a series lamp, the size being selected to give the desired output voltage from the genemotor. The increased current drain from this system is sufficient to keep the "A" battery charged.

It is very wise to solder the leads to the "A" battery terminals as a corroded connection here may produce sufficient voltage drop to damage the valves.



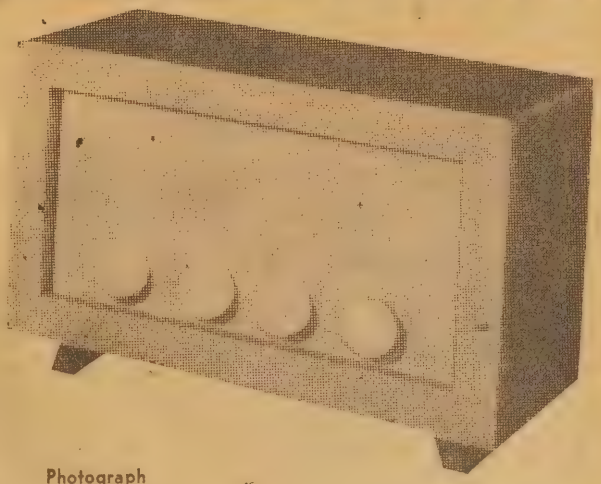
TRADE REVIEWS AND RELEASES

NEW REPRODUCING SYSTEM FROM AEGIS CONNOISSEUR

AEGIS MANUFACTURING COMPANY of 208 Little Lonsdale St., Melbourne, have produced a new amplifier of unusual styling. The amplifier features separate bass and treble controls in addition to a loudness control which preserves balance between high and low frequencies at any setting of the volume control.

Frequency response is given as 40—15,000 cycles plus or minus 2 db with the controls in the flat position. The output impedance is 2.3 ohms, as the amplifier is intended to operate with the Rola 120-X speaker or equivalent. Aegis have produced a special enclosure for this speaker which, although measuring only 22 x 20 x 16 inches is claimed to produce a smooth response down to 40 cycles per second. It is made of ¾in walnut veneered corestock panels. The enclosure may be ordered in five different finishes and styles the design of which matches that of the amplifier itself.

Aegis distributors will be pleased to demonstrate the performance of this interesting new line.



Photograph of the Aegis Amplifier

MC2-111 Scotch Boy Recording Tape

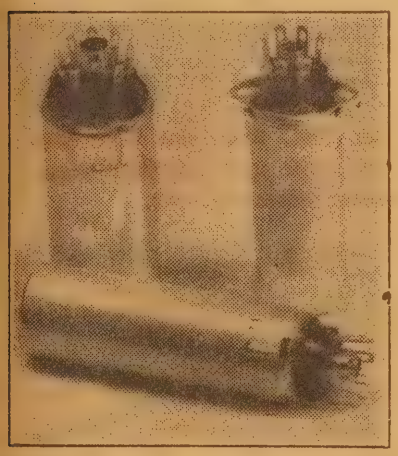
W. J. McLELLAN & CO. PTY. LTD. have sent us a sample reel of the new Scotch Boy magnetic recording tape type MC2-111 for which improved results are claimed over the earlier type.

The new tape has been designed to provide higher sensitivity, lower noise level, and less tendency to stick to the recording head through a new self-lubricating feature. It is intended to supersede the MC-111 as being a superior product.

Our use of the tape confirms that the improvements claimed for it are noticeable in practice without the need for a special test set up. The improvements give a greater margin of safety particularly in recording levels, and make it easier to obtain well modulated, low background recordings on standard type equipment.

MINIATURE SHIELDED SOCKETS

Messrs. Wm. J. McLellan announce that they have added several new items to their range of "Teletron" products. In addition to the familiar miniature 7-pin socket with shield, they are now able to supply shields for the taller miniatures and also for the 9-pin "Noval" series.



THE smaller 7-pin shield/socket combination is intended for use with valves like the 6BA6, 6BE6, &c. The new and larger shield is tall enough to accommodate valves like the 6AQ5, 6X4, &c.

A similar choice is available in shields to suit the 9-pin "noval" series of valves. The smaller shield is adequate for valves like the 12AT7, 12AU7, &c., the larger shield being for the 5673, 6T8 and such like.

The sockets themselves can be supplied, as required, moulded from ordinary black electrical grade powder or from a special mica-filled powder.

Where only partial shielding is required, the socket can be supplied with the skirt portion of the shield, which is integral with it. This gives support and protection to the valve and shields it for about ¾in above the chassis line.

The manufacturers point out that the shield is of brass, tin plated and then cadmium plated to ensure freedom from corrosion during service.

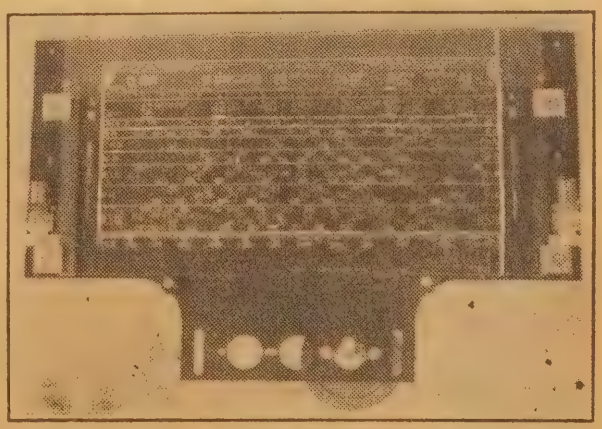
Available through trade houses. Trade inquiries may be directed to Wm. J. McLellan & Co. Pty. Ltd., 126 Sussex St., Sydney.

NEW DIAL FOR TRIPLE-WAVE SETS

FOLLOWING the description of the Radio and Hobbies Multi-Band DX Receiver (August, 1953), the Efco Company has released a new triple-wave glass for the standard USL46 dial.

The glass, which measures 5½ x10½ inches is marked in orange and pale blue, with important figures and metropolitan station calls in white. It is calibrated for the AWA type gang only and will suit coil kits having the nominal coverages of 13-42 metres, 42-105 metres and broadcast band. Both metre and megacycle calibrations are shown for the two short-wave bands.

A useful innovation is the reference mark for the pointer with gang fully closed.



MORE ABOUT TAPE RECORDER NO. 2

A typical set-up for the Tape Recorder No. 2 Amplifier, used in conjunction with a phonograph type tape deck and housed in a home-made wooden cabinet. The design of the amplifier is such as to minimise overall height and allow it to slip beneath a deck. Plans for the special chassis appear on page 87.

Since describing the "Tape Recorder No. 2" amplifier, in the March 1953 issue, we have had many requests for details of the chassis layout and for guidance in its use in a complete tape recorder. Here is a description of how it was built as a unit into a cabinet.

THE No 2 circuit, you may remember, follows along the same general lines as the No. 1 amplifier (November, 1952) but is rather more suitable for use with conventional decks and in conventional applications. Points of difference are:

(1) All functions are controlled by a single "Record/Play" switch.

(2) It has a power oscillator for erase and bias.

(3 It uses a low noise preamplifier valve and gives no trouble with feedback from a built-in speaker.

(4) When recording, the monitor volume can be controlled separately and maintains a proper tonal balance at all times.

Like the No. 1 Amplifier, it relies purely on R/C circuits for its compensation, and does not use resonant or trap chokes of any description. This renders the design less specialised and ensures reasonable results from a variety of heads and at different tape speeds.

It is, therefore, a safe "general-purpose" design for experimenters, although it lacks the sharply peaked characteristic which is often used by manufacturers to get the last particle of response from their heads. Nevertheless, as originally tested with a good quality full-track head, the response was substantially level to between 7 and 8 Kc.

The only difficulty which has arisen with either of the circuits has been a tendency to accentuate the bass with some heads, leading to over-recording and consequent distortion on low notes. The effect is aggravated, of course, where layout or other considerations have tended to produce low frequency instability.

SMALLER VALUE

The simplest method of correcting this is to reduce the value of the coupling condenser between the first two valves. Instead of the .05 mfd value originally specified, try reducing it to .02 or even .01 mfd. Reduction in the bass response by this means to the minimum usable amount will also reduce the severity of hum should this be picked up by the head from adjacent motors and transformers.

Quite apart from this specific problem, some tape experimenters have met with severe distortion and low recording level at all frequencies. Almost invariably, this trouble has been traced to insufficient bias current during recording. Once this has been lifted, by one means or another, to an adequate figure, distortion and level problems have disappeared.

As we have pointed out before, no great reliance can be placed on bias voltage readings taken with a multimeter. The readings are affected greatly by the meter's internal wiring capacitance and also by the particular bias frequency. You should be able to read better than 100 volts across the record head and over 200 volts across the erase head, but these figures cannot be regarded as anything but a general guide.

BIAS VOLTAGES

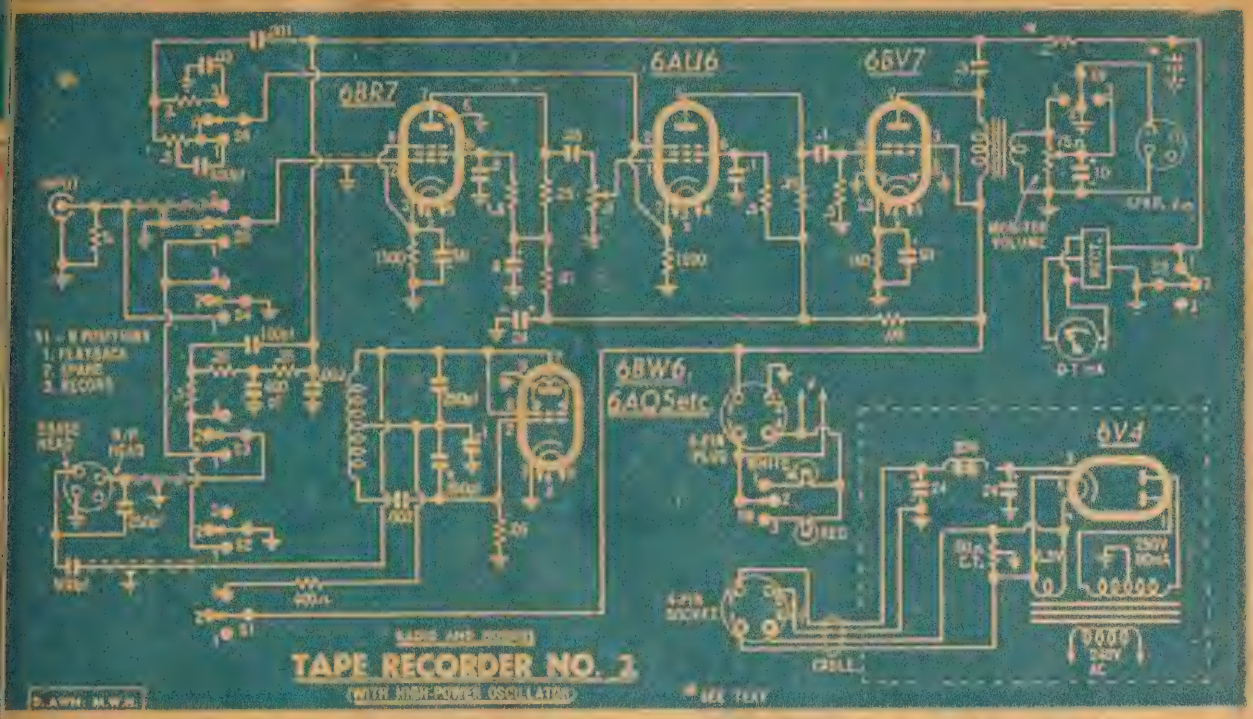
Using typical heads and components, it is most unlikely that you will ever be troubled by excessive bias or erase voltage. Lack of bias is far and away the more common complaint.

Because of this, it is a fairly safe procedure to experiment with the coupling circuit with a view to achieving the maximum possible voltage across the heads at the selected frequency. Readings on the multimeter can then be taken purely as an indication of whether the bias has been increased or decreased by a particular adjustment.

The operating frequency of the oscillator is determined mainly by the condensers connected across the coil. In the No. 2 circuit, we showed two .00025 mfd condensers in series, giving an effective tuning capacitance of about .00013 mfd.

While this gave a bias frequency just above 50 Kc, other coils frequently have lower inductance, allowing the tuning condensers to be considerably larger. Due note should be taken of specimen circuits given by the coil manufacturers and values of up to four times those suggested are quite in order (i.e., as high as .001 mfd).

Reducing the resonant frequency of the oscillator will often reduce the bias and erase voltages, as read on a meter. However, it may easily increase the all-important bias and erase current through the heads, because of their reduced impedance at lower frequencies. That is why we used the wording a little earlier . . . "experiment with the coupling circuit to achieve the maximum possible voltage at the selected frequency".



This is the complete circuit, as originally featured in the March, 1953, issue. Compensation is applied during both recording and playback, being achieved purely by R/C circuits. As in all record/playback amplifiers, extreme care is necessary to isolate the input and output functions and thus avoid feedback problems. Power supply is on a separate chassis.

We have suggested a 500 pf condenser as a typical coupling value between the bias circuit and the erase head, with a further 250pf condenser to the record head. It may well be that a slight increase or even a reduction in the value of the 500pf condenser will produce higher voltage across the erase head, due to a series-resonance effect.

It is even possible, because of this effect, to have a higher voltage across the head than is available directly from the coil.

However, do not be tempted to increase the coupling condenser to more than about .001 mfd in an attempt to get a fractional increase in voltage. Large coupling values will merely act as a shunt for the audio circuit.

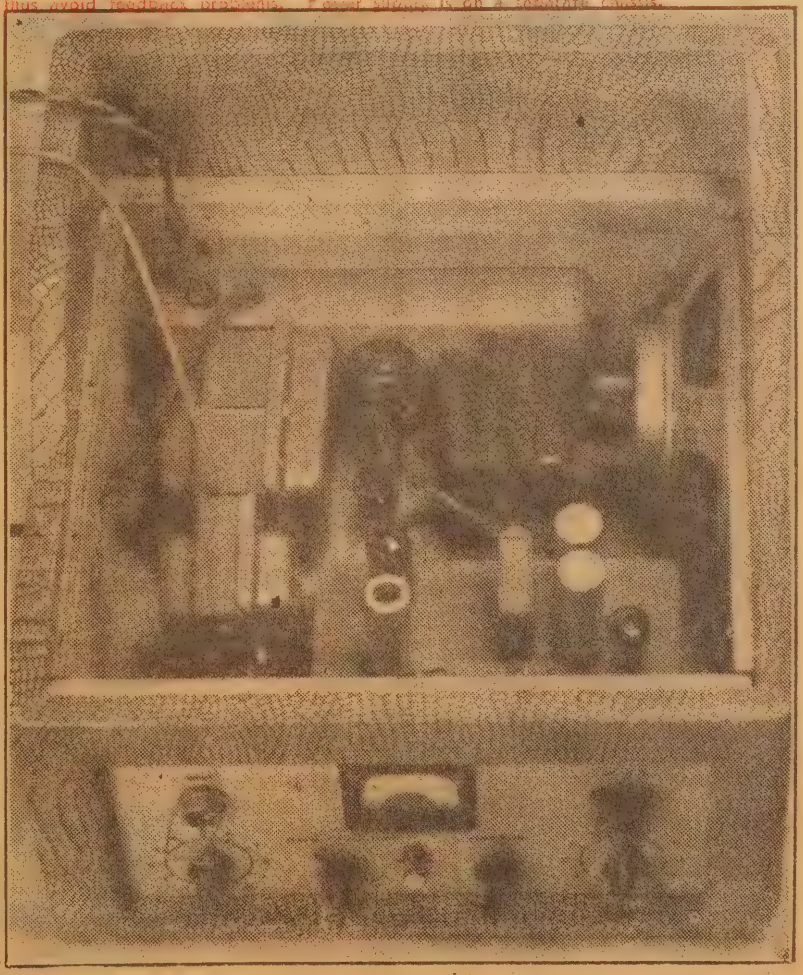
MAXIMUM COUPLING

If difficulty is experienced in achieving a resonance effect or in obtaining sufficient bias, as judged by results, it is better to lower the bias frequency rather than to go to prohibitive values of coupling condenser.

Needless to say, the shielded leads between the heads and the audio and bias circuits should not be longer than necessary, in order to minimise capacitive shunting. For the same reason, it is wise to use light duty coaxial cable in preference to some of the very large capacitance shielded wire that is now current.

Points like these have emerged both from talks with readers who have built the amplifier and from our own experience, using it with a variety of commercial and home-made heads.

The original chassis, on which the amplifier was built, was bent up with hand tools and vise specially for the purpose. In an effort to conserve overall height, we put a step in in corner of the chassis to allow the



Looking into the cabinet with the motor removed. The power supply, lying on its side, just clears the speaker and amplifier chassis.

"TAPE IT FROM HERE" with the MAGNOFILM

TAPE DECK, MODEL TM-1

Features:

Supplied complete with amplifier circuit for recording from Microphone, Radio or Pickup and for dubbing from tape to disc or disc to tape.

Two tape speeds—7½in per sec. at 78 r.p.m. 3¾in per sec. at 33 1/3 r.p.m.

Loads 1200ft tape on standard 7in. spool.

Constant Speed Drive.

Wide Range Frequency Response.

Mechanical Rewind.

Direct Coupling to Turntable.

Instant Mounting and Removal.

Low Cost.

Separate low frequency erase unit included.

The Magnofilm Tape Deck, Model TM-1, has been developed to provide a really high quality tape recording and replay mechanism for the enthusiast at the lowest possible price. The success of this unit is due to its simplicity and ability to record faithfully with professional clarity. This has been accomplished by utilizing as a driving medium the power from a gramophone turntable, which provides (in the better types) the very desirable features of constant speed and high kinetic energy. The heavy flywheel action of any B.R.S. turntable unit or disc recorder makes it ideally suited for this purpose. The "sound quality" obtainable from the Magnofilm Tape Deck is derived from a first class record/replay head of unique design and manufactured to the same high standards that typify all Byer audio equipment.

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Byer Industries
PROPRIETARY LIMITED

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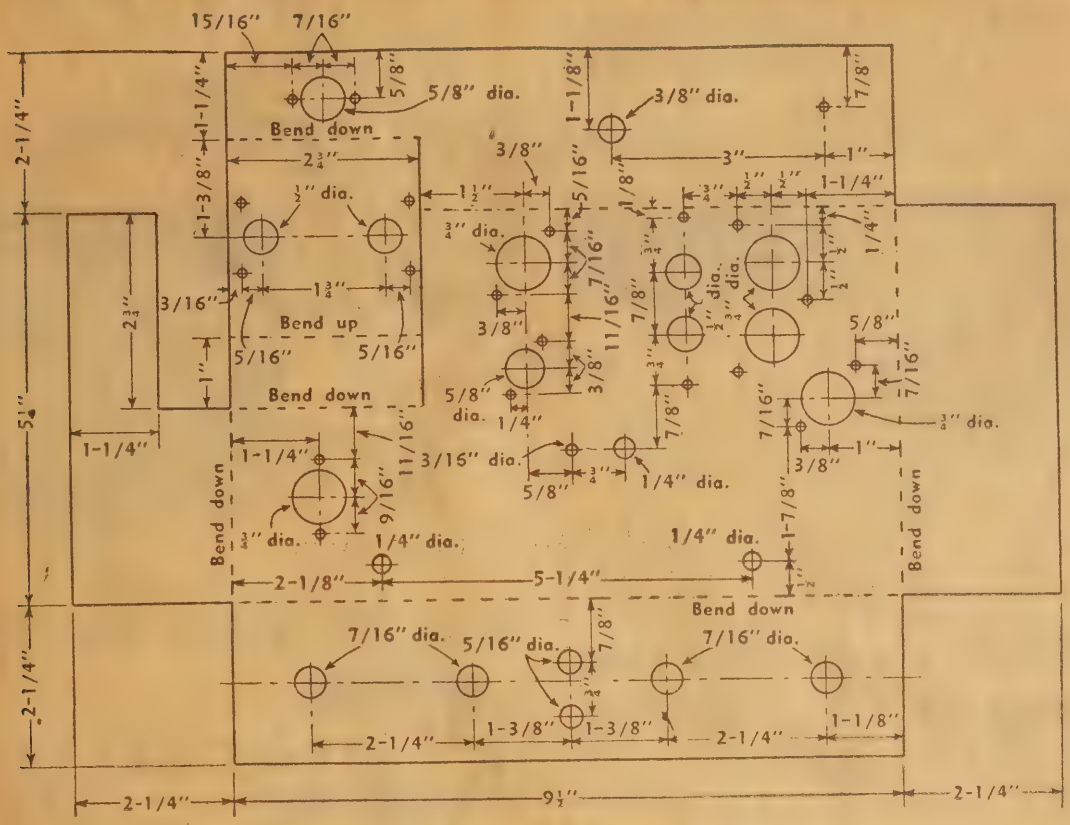
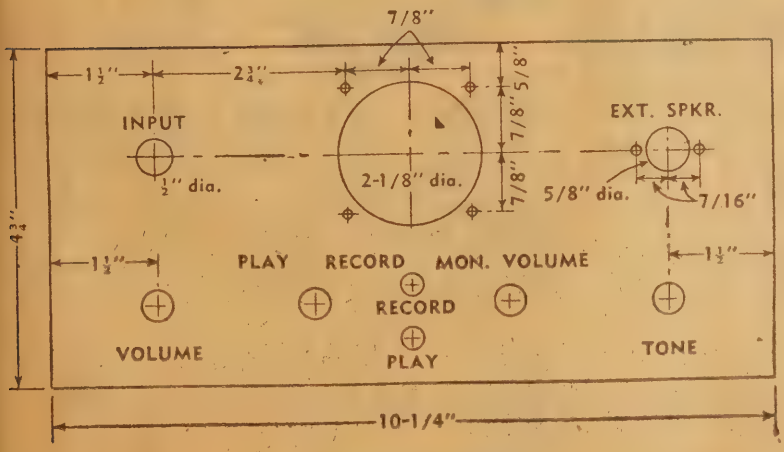
CHASSIS DETAILS FOR TAPE RECORDER No. 2



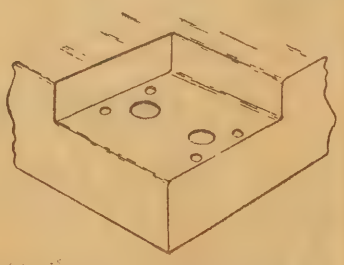
PLAN OF CHASSIS

Note: Diameter of all holes not indicated are 1/8".



FRONT PANEL

(All dimensions not shown are the same as for dimensions of corresponding holes in chassis diagram.)



Corner of chassis bent inwards as indicated to accommodate output transformer.

Plans for the special chassis required for the Tape Recorder Amplifier No. 2.

output transformer to drop to the height set by the valves and other components.

The chassis would be more difficult to bend up commercially than a conventional type and we suggested that the amplifier could be built up equally well on the same chassis as for the No. 1 Tape Amplifier.

We have since had many requests, however, for details of the special chassis and a few readers appear to have "rolled their own" working only from photographs and overall dimensions. We have now prepared a drawing showing essential details of the chassis so that it can be duplicated exactly by those who may wish to do so.

For general use around the writer's home and ham-shack, the recorder has been used most fre-

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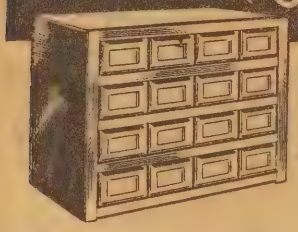

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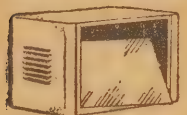

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Instrument boxes, black krinkle, complete with panel.

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8in metal, round, suitable car radio or home extension speaker. Choice of green, cream, blue pastel finish. Post Free. Part No. 3N45 .. **22/6**

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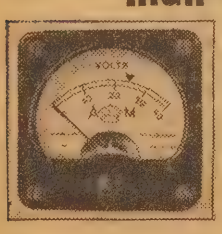

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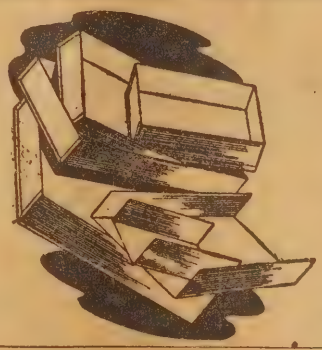

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6AV6	1
6B7	2
6BA6	1
6BD7	1
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6BH5	1
6BR7	3
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uently with a couple of phono-raph-type tape decks. One is a ommercial unit, as pictured, with a illtrack head and intended for bulk)-cycle erase, the other is home-ıade (see the December, 1952, issue) sing a pair of commercial twin-rack heads.

In an effort to keep the recorder ı one piece, rather than as a col-ction of chassis and wires, a couple f nights were spent building up a ase for it. Neither the cost of mater-ls nor the task of building such case is beyond the capacity of a omebuilder.

While neat and serviceable, the ase is quite functional in design nd does not pretend to compact-ess or glamor. The main point is ıat it is a lot more permanent nd convenient than a mere collec-on of bits and pieces on the bench, ıough everything is readily acces-ble when tape experiments have) be carried out.

The case was made from ½in. oard and 3/8in. ply and has an ıternal dimension in plan of 11¾in. quare. It is 6 5-8in. deep at the ront and is extended up to 9in. eep at the rear to provide protec-ion around the back of the tape eck.

The dimensions were simply elected to contain all the compon-nt parts in appropriate positions. The unit is used without a lid and, ı operation, the reels overhang the ear and sides of the case by a small mount.

OWER SUPPLY

The power supply unit lies flat on ıe floor of the cabinet, a partial hield serving to hold the rectifier ı its socket.

This works out very nicely in erms of space but, before making ıe cabinet, we carefully checked the elative position of all components) make sure that the most conven-ent physical positions were not ıose which gave a high level of um pickup.

This involved propping the motor p on a makeshift board, putting the eck into position, sliding the am-lifier and power supply under-eath and listening to hum level vith the gain advanced, while the arious components were juggled round. Very fortunately, for once, ayout and performance were not too ifficult to reconcile.

The motor is an ordinary inex-ensive rim-driven type, able to run he recorder but with nothing to pare. It is adequate for speech nd routine testing but is not above riticism for serious high-quality ecording.

Naturally, however, an elaborate ıotor would be more costly and more ulky and would necessitate a differ-nt physical layout.

A different approach again would e necessary if a cabinet had to be levised to house a self-contained eck. It would be a matter of ex-erimenting with the relative posi-ion of all the components to strike he best compromise between disposi-ion, overall size and freedom from um. It is distinctly an individual roblem which is not likely to be as-isted much by plans of our own ffort.

The cabinet, after having been as-embled and sanded, was duly cov-red with leatherette, using "Casco" ype glue and using nothing more laborate than scissors, razor blade, ule and the kitchen table!

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NO NEED TO WAIT FOR ANYTHING BETTER

'NOVATAPE' RECORDERS

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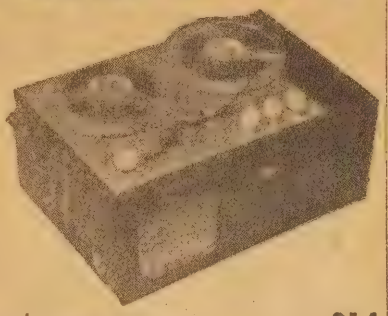

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22	23	2d	2d	2d
24	25	1d	1d	1d
26	27	1d	1d	1d
27	29	1d	1d	1d
28	30	1d	1d	1d
30	33	1d	1d	1d

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HINTS ON USING FLASH BULBS

Most amateur photographers at some time consider the possibility of using flash illumination for adverse daylight conditions or at night. This article describes some of the characteristics of the expendable type flash bulbs, particularly those most suited to the amateur.

THE electronic flash unit, either home-made (as the Radio and Hobbies Electroflash) or in commercial form, has many advantages, not the least of which is the low running cost. However, viewing the whole subject objectively, it must be admitted that these devices also have some disadvantages.

One of these is the high first cost. While not an objection for professional work, it puts them out of the reach of the amateur with simple equipment and who may only require such facilities on odd occasions.

In cases like these one might seriously consider the expendable flash blub, in spite of its apparent disadvantage of high cost per shot. In the first place it must be appreciated that these bulbs may be used with the very simplest of equipment which can normally be constructed by the ave-age amateur for a few shillings. This is a very important point when the amount of work to be undertaken is strictly limited.

Another advantage is the fact that such equipment weighs only a few ounces and takes up very little space, something which cannot be said of the electronic flash in spite of recent improvements. For this reason it is possible to carry and use flash bulbs in circumstances where no other form of light would be practical, and to obtain pictures which would otherwise be lost.

LOWER PRICE

It is also pleasing to note that there has recently appeared on the market a bulb of Continental make (Wotan XP), which is a good deal cheaper than any previous type, costing only 6/11 for five bulbs, or about 1/4½ each. Admittedly, these are smaller, both physically and in terms of light output, than previous types, but this is not a serious disadvantage, and, in fact, can even be an advantage, as we shall see later. It seems most likely that the introduction of electronic flash units has been partly responsible for this reduced price.

Probably the most important point of all is that many photographs have a value which is difficult to assess in terms of shillings and pence and in these cases the cost of a few flash bulbs will be negligible compared with the intrinsic value of the picture in years to come. The important thing is to be able to take the picture at the appropriate time and place and a few flash bulbs and the necessary equipment will often mean the difference between a picture and no picture.

So much then for the general considerations; now let us discuss the bulbs themselves and their manner of use. In appearance they are something like an ordinary light globe, varying in size from that of a car headlamp globe to a standard 75-watt domestic globe. In between these two extremes most makers have a variety of sizes to suit particular requirements. Quite naturally, the larger sizes give more light —and are more expensive.

MAGNESIUM FUEL

Inside the glass envelope there is either a mass of very fine magnesium wire or a bunch of magnesium foil. There is also a firing fuse to ignite the wire or foil, while the envelope is filled with oxygen to assist combustion. The base of the bulb varies with the type and size, though the most popular are the standard Edison Screw (ES) and the miniature bayonet base (single contact) as used in car electrical systems.

To guard against risk of injury in the rather unlikely event of the globe exploding when fired, it is customary to coat the glass, both inside and out, with a heavy coating of clear lacquer. This provides an adequate shatter-proof characteristic even if the glass should break.

To fire the globe it is only necessary to apply a low voltage (3 to 4.5) to the base contacts, this firing the fuse and igniting the metal foil which burns with a brilliant light. The duration of the flash depends on the type but varies from about 1/200 second to 1/50 second.

WARNING: After firing, the bulb will be very hot and should not be handled with the bare hands.

The simplest possible way of using these globes is by what is called the open flash method; where the camera shutter is set on time, opened, the flash fired, and the shutter closed again. This method can be used with virtually any camera, even the simplest and oldest box camera. Naturally, it is a little clumsy by comparison with a Press photographer's methods, but it is often quite satisfactory for the amateur.

One popular scheme is to use an ordinary electric torch as a battery-holder and switch, the regular reflector, globe, and glass being removed. Some flash globes are fitted with miniature ES bases to facilitate this, or a simple adaptor can be made to accommodate larger sizes.

REFLECTOR

To make the maximum use of the available light it is necessary to use some kind of reflector behind the globe, and this can vary from a simple cardboard affair to a more elaborate plated metal type such as was used for the Radio and Hobbies Electroflash (September, 1952). The battery holder, reflector, and necessary mounting bracket are grouped under the title of "gun"

A much more satisfactory arrangement is one where the gun can be attached to the camera and fired

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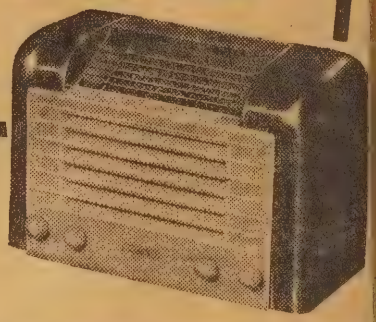

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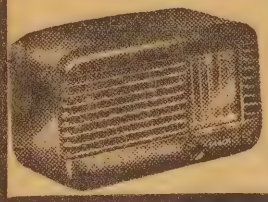

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automatically at the moment the shutter is operated. One disadvantage of the simple open flash method already described is the possibility of a secondary or "ghost" image caused by the general illumination, if this is very high, or if the shutter is left open too long.

If some means can be devised to synchronise the firing of the globe with the opening of the shutter this effect can be avoided. In addition it may even be possible to use a very high shutter speed to stop movement, using only the peak portion of the flash.

The degree of synchronisation possible depends on the equipment used and we will now consider the various systems. The simplest arrangement is really only an improved version of the open flash method and is generally suitable for use with all modern cameras, including box types, which are fitted with contacts.

SHUTTER CONTACTS

These contacts are built into the shutter mechanism and are arranged to close at the moment the shutter mechanism actually releases. Connection is made to them by means of a miniature screw type socket built into the body of the camera. A corresponding plug is attached to a short length of flex coming from the gun.

A simple bracket is usually required to allow the gun to be attached to the camera, the tripod socket being a frequent point of attachment.

The next question which arises is: What shutter speed should be used with such an arrangement? This brings us to a consideration of the firing characteristics of the bulbs, which is slow relative to many of the times we are accustomed to use on a modern camera.

The exact time varies from type to type and the makers should be consulted for precise details. However, it is generally in the order of 1/75 to 1/100 second, this being called the ignition time and being taken as the time required for the light to reach half its peak value. From here on the bulb will continue to burn through the peak value and down again to the half peak value. At this point the flash is regarded as finished. The period of the flash may vary from 1/200 second to 1/40 second, so that the total time from the closing of the circuit to the effective end of flash can be as long as 1/20 second.

LOW SHUTTER SPEED

In the absence of complicated equipment we can only allow for the ignition time by using a shutter speed which is at least as long as the combined ignition and flash time. For most of the smaller globes this will be in the order of 1/25 second, though the new very small ones are somewhat faster and could be used at 1/50 second. It is even possible that they could be used at 1/75 second, but this is pushing matters very close and would seem to be unwise in most cases.

In order to achieve complete synchronisation it is necessary to employ either a shutter having special contacts (and a special price tag!) or a synchroniser. The synchroniser is a contacter which fits between the cable release and the camera shutter. When the release is pressed the flash contacts are closed immediately but the shutter mechanism is not actuated until a gear train has operated for the required time. Thus the shutter commences to open at the same time as the flash commences to burn.

In the case of the special shutter a similar device is simply built into the existing mechanism, in some cases having the additional feature of being adjustable to suit different types of bulbs.

The three most usual types of contacts fitted to shutters are the "X", the "F" and the "M". The "X" type are fitted to most cameras and close at the moment the shutter releases. The "F" type introduce a delay of from 3 to 5 milliseconds (msec.) and the "M" type a delay of from 16-17 msec.

EXPOSURE TIME

The next question is that of exposure. Except where synchronisers are fitted the shutter plays no part in the actual exposure time and the only control left is the lens stop. This will need to be adjusted according to the distance from the light to the subject and for this purpose use is made of what are called "guide numbers".

These numbers apply to any given combination of flash bulb and film speed and are so calculated that, when divided by the distance to the subject (in feet), they give the correct stop opening. Thus a typical guide number for one of the smaller bulbs when used with Super XX, or similar film, would be 130.

If working at 12ft from the subject we divide 12 (the distance) into 130 (the guide number) to give 11 (the stop opening). Guide numbers are normally supplied by the bulb manufacturers but we quote the following as a matter of general interest.

In the Philips "Photoflux" series the PF14N, the smallest at present supplied by this company, has a figure of 180, the PF25 240, and the PF60 400. A smaller type, the PF3, is due for release shortly and is rated at 130.

Exact figures are not at present available for the Wotan XP, but this would also appear to warrant a figure of 130. All the above figures are based on Super XX film, or similar, but would have to be lowered for fine grain types. They also assume a reflector of average efficiency and some reflection from room walls. For outdoor work at night they would need to be modified. In most cases one stop larger should be sufficient.

Where the guide number for one size bulb is known it is possible to arrive at the number for any other bulb, providing the total light output of each is known. This is normally quoted in manufacturers' data sheets as so many lumen-seconds and the ratio of these two figures will be ratio of exposure. Thus a bulb having twice the light output will obviously call for a lens aperture one stop smaller and one with four times the light, an aperture two stops smaller.

USING GUIDE NUMBERS

To increase the exposure by one stop, multipy the guide number by 1.4 and to decrease it, multiply by .707. To change it by half a stop the factors are 1.25 and .816 and for one and one-half stops, they are 1.73 and .578. For the more mathematically-minded the figure is simply the square root of the exposure ratio, or the reciprocal of it, according to whether an increase or decrease is involved.

A little calculation will show that the amount of light available can be embarrassingly high when working at short distances. Thus a PF14N at 4ft would call for a stop of f45, a value which is never heard of in these days of miniature cameras and fast lenses. Even a figure of 130 calls for a stop of f32 which is not always available.

(Continued on Page 111)

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OFF THE RECORD — NEWS & REVIEWS

A remarkable result following the introduction of the LP record has been the popularity of the master musicians. Beethoven in particular has virtually achieved the status of a best seller—his Toscanini Ninth Symphony heads the appropriate lists in America. This month's review considers some local Beethoven releases.

BEETHOVEN—Symphony No. 3 in E flat (Eroica) Opus 55 played by the Austrian Symphony Orchestra conducted by Fritz Busch. Festival CFR12-91.

The original recording of this disc was by Remington and it is pressed in Australia by Festival.

As a recording I think it has the edge on those I have heard so far. It is commendably clean and the balance is good, with if anything an emphasised bass response which can be satisfactorily reduced when playing. The depth of cut does not appear to be heavy, and the orchestra a little remote, but not unduly so. The surface is commendably quiet, and for the most part can be ignored.

The frequency response is not extreme after the manner of some Westminster discs issued by the same company, but it is quite good.

This is the first big work I have heard by this orchestra, and it makes its way through the score with credit. The performance is a straightforward one, a little inflexible in parts, a little lacking in smoothness here and there, but its dynamics are good and better than in some other more famous recordings.

It plays quite cleanly with the average crystal pick-up, and merits very little criticism even on the wide range gear.

One of Festival's most sucessful records.

BEETHOVEN — Concerto in D Major, Op. 61, played by Zino Francescatti and the Philadelphia Symphony Orchestra, conducted by Eugene Ormandy. Columbia 33CX-1011.

So many of the "great" composers wrote only one violin concerto each that one often wonders why. It may be that the task is so formidable that even men such as Beethoven didn't feel they had material sufficiently appropriate to face it.

The actual musical form of a concerto is quite similar to that of a symphony, but there is mentally and emotionally a big difference. The addition of a soloist means not just another player, but an individual musical expression of sunfficient importance and weight to pit itself against a full orchestra in exposition and argument.

In relief, it must be mentally and technically impeccable—it must have a reason for being, not just manufactured to fill a convention or to provide virtuosity. And yet it must accommodate both these things with stature and conviction.

NEEDS HIGH STANDARD

That is why I think so many violin concertos by lesser men are only partial successes as musical achievements. Many of them are charming and pleasant to hear, but only a genius who has something really worth saying can reach the front rank. Played by a soloist of appropriate musicianship and technical ability, the great concertos may well represent the highest and most intimate in musical expression.

It requires, therefore, a very special combination to give a notable performance of the Beethoven violin concerto. This record has its share of both success and failure. There are times when the orchestra and violin achieve complete and commendable fusion, but there are others when the individualism of the Philadelphia players seems to work against them. This may be in some part due to the forwardness of th recording and some lack of rever beration which is quite noticeable

In general, the violin tone is fu and strong as it must be in a wor like this. Intonation is excellen The all-round rating of the recor is very good, and its plays quit cleanly. But it isn't the one I hav been waiting for.

BEETHOVEN—Symphony No. 5 i C Minor, Op. 67, played by th Vienna Philharmonic Orchestra, con ducted by Herbert von Karajar Columbia 33CX1004.

This is a disappointing disc. Th recording standard would have bee acceptable 15 years ago, but is fa below today's requirements. It i blurred and rough, with limited fre quency range and frequent poo instrumental balance. It is almos certainly a dubbing—one can hea what sounds like a bad switch fron one side to another in the first move ment. It cannot be compared wit the Philips record reviewed recently Columbia can do better than this.

BRAHMS — Symphony No. 2 i D Major played by the NBC Sym phony Orchestra conducted by Arturo Toscanini. HMV ALP 1013

This record was issued at abou the same time as Toscanini's re cording of the First — among the earliest releases by HMV in Aus tralia. Its popularity is well de served and understandable, for i contains some of his best and mos typical orchestral music.

There is little point at this junc ture in commenting on it as a sym phony, for most people have settled their own arguments, if they have any, about Brahms.

The vast majority of record buyers will without hesitation class it among the standard works they sooner or later wish to acquire. For beter or worse it is all Brahms, and more than this, it is Toscanini Brahms. I have heard many recordings of it, and have played them many times, but I doubt whether I have ever heard a better one.

FIRM HANDLING

Toscanini is often criticised for his forthright methods, but in this recording there can be little criticism on that score. I feel that Brahms in his orchestral works must be handled firmly and enunciated clearly. Only a first rate musician and an orchestra sensitive enough to follow him can capture the full magnificence of Brahms. Lack of complete mastery of the score inevitably means a vague, slovenly, and incredibly dull performance.

To both conductor and orchestra I here award nearly full marks. Strangely enough I felt the lack of some crispness and drive in the last movement, but some of this lack may be due to the recording, which isn't of the wide range type. It is

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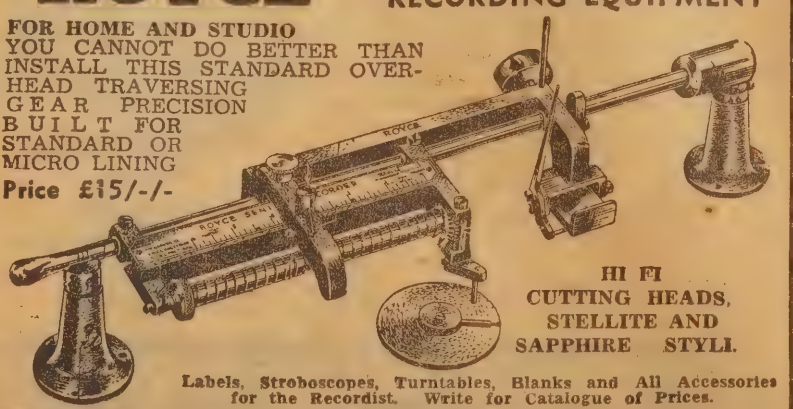

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quite acceptable, good average work, but not up to today's best. The bass is strong and if anything a little drummy. But it is a safe record, and should play well on any equipment.

BACH—Mass in B minor played by the Vienna Symphony Orchestra with chorus and soloists conducted by Hermann Scherchen. Westminster WAL301.

A truly formidable composition considered by many to be one of the greatest of all musical works. Like so many of the period it has a religious background, but it is not really a church Mass. Its 24 parts are on three LP discs in an album, and the recording was awarded the 1951 Grand Prix du Disque award. Three pages of annotations by Edward Tatnall Canby describe the music, and there is a fourth page of reviews published in America when the records were released at the end of 1950.

ESSENTIAL BALANCE

To all the enthusiastic things which have been said about these records I fully subscribe. They are well worth an award as examples of what engineers and musicians who understand records can do. They are so good that although one can imagine them being treated differently by other engineers, it is hard to imagine them being any better for it.

Most important requirement for such a recording is balance. The orchestra is heard sometimes alone, sometimes with soloists, or with chorus, or with both. At times there is an important woodwind passage to be heard, or a horn, or an organ (not a modern type but one which might have been played in Bach's day). It is here that the recording engineer has done so well. Not a significant note has he lost.

Worthy of special note is the choral singing—so often the "hard bit". It has been kept at a safe distance, but we must remember the array of soloists and the orchestra all of whom have to be sited as well. The soloists are all of good quality and are heard in the great presence and realism.

My only criticism is that some of the discs tend to develop distortion near the centre where occasionally there is some heavy work. They are no worse than many other records, but its a pity because elsewhere the pressing is faultless and the surface impeccable.

This may not be everyone's music, but in its way it sets a standard in reproduction.

MENDELSSOHN — Symphony in A minor (Scotch) Opus 56 played by theVienna Symphony Orchestra conducted by Otto Klemperer. Festival CFR12-146.

Few composers could express sunlight and shade as well as Mendelssohn who is so often considered an eminently respectable but poor relation (in a musical sense) to the accepted giants. I say poor in a musical sense because in contrast to the giants themselves (with a few exceptions) Mendelssohn was anything but poor, being successful, wealthy and extremely happy in his life.

No doubt had his path been a harder one his music would have reflected a more sombre note. But it wasn't, and so we see no introspection in his music, or if we do it is doesn't go very deep and is soon dispelled.

A good example of what I mean is seen at the beginning of the second movement of this symphony, where a cloud passing over his sky is suddenly chased away by an irresistible flurry of sound.

This exceedingly competent symphony is Scotch in name only, for neither Annie Laurie nor the incomparable bagpipes grace its notes in fact or fancy. It was born during a visit to the Hebrides which produced among other things the famous overture of that name. There is much of the same spirit in both works, but it's really just Mendelssohn when all is said and done — a graceful, competent, easy-to-hear writer of music for its own sake in which field he is rarely equalled.

I thought this record a particularly good one, made by Vox incidently. The Vienna Orchestra as usual gives a splendid performance. Klemperer of course is known to us in person. The recording itself is smooth, well balanced, and clean. The only passage even mildly fuzzy is at the very last half-inch, and it doesn't show up badly on the average radiogram. The surface is better than average. I recommend this disc as music for anybody.

SMETANA—Quartet in E Minor; DVORAK — Quartet No. 6 in F Minor, played by the Curtis String Quartet. Westminster WL5199.

Two interesting recordings from two Czech composers of great significance, certainly to the music of their land. Dvorak's is known both as the "American" and the "Nigger" quartet because of its association with negro spirituals met with by Dvorak during his period in America. The allusion is somewhat ephemeral, however, rather than literal. Smetana's work is just as much Czech as the Moldau music which belongs to the same era.

The recording on both sides is vivid, almost deadly, and I think rather too hard on the players, whose every lapse from grace, nor matter how slight, cannot escape detection. Maybe this is why the quartet at times sounds unduly disconnected and unbalanced. For instance, at one moment we hear a very strong pizzicato from the cellist, but very little from the second violin.

In the next breath the players have fallen into perfectly satisfactory balance and blend. Were the microphone a little more remote, I'm sure cohesion would have been improved Many times a more sensitive touch would be appreciated.

Unfortunately I found both sides rather hard to play for the last few inches. Wide range equipment will, I fear, detect a roughness on the first violin which could be eliminated only by appreciable top cut. The quietness of the surface makes this more noticeable. The Dvorak I liked the best, although I didn't consider the quartet the equal of the Vienna players recently featured by Westminster.

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(Continued on Page 97)

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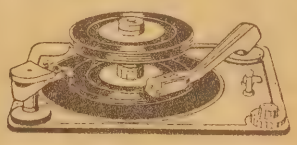

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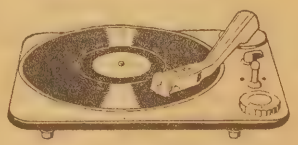

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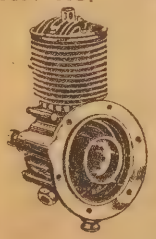

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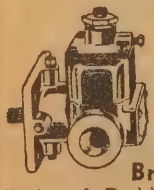

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RECORD NEWS FROM OVERSEAS

When Columbia and RCA Victor began their Microgroove issues only a few years ago, the record buyer would have been excused for thinking simply "What speed will it be?" As events have proved, the question has rather become "Whose records will I buy?"

BY DISCOBOLUS

THE facts are that all equipment worthy of the name will play records on all speeds, and that the buyer now has the products of almost two hundred companies from which to choose. Everyone with a tape recorder and a few dollars at the bank has tried to get in first on the LP market, with results to the music listener which can only be described as satisfactory.

In America, for every work of musical interest, there is something for everybody—your favorite price, the artist you want, or the high-fidelity version you'd always dreamed about.

The growth of the catalogues is almost beyond belief. To give a typical example, take the case of the Beethoven Choral Symphony.

Early in 1952, this was represented by three recordings, by Koussevitzyk, Ormandy, and Bruno Walter. In one single week in November, 1952, there appeared the versions by Toscanni, Scherchen, and Kleiber. Since then, two more have been released, and a ninth recording will be issued shortly on the Epic label (which Philips will use on the American market for their European discs).

RAPID GROWTH

If you like the Beethoven 5th Symphony, it is on sale on 10in records by three companies, on 12in by eight others, or, if you want value for your money, on a 12in coupled with Mozart's Jupiter, or by Toscanni coupled with the Leonore Overture, No. 1. Mercury will try and sell you a 12in containing also the Coriolan, Egmont, and Leonore No. 3 Overtures.

Columbia have the Pictures At An Exhibition on a new disc by Ormandy with the Stravinsky Firebird Suite on the reverse. Or, among eleven versions of the Grieg Concerto, there is a coupling by Lipatti of the Schumann. All for the price of an ordinary LP containing one of them only by other companies.

Given the quality, competition for quantity could be a good thing.

The market outside America also is showing much activity of late.

NIXA, as will be seen from their labels, are selling what were, in USA, the records of Period, Concert Hall, Haydn Society, and now Vanguard, Urania, and Musical Masterworks Society. In England, they have commenced the release of Westminster.

Festival, as well as handling Remington and Westminster locally, now have access to Vox. And, in England, Decca are about to press and issue the French Oiseau-Lyre catalogue, beginning with another recording of Bach's Christmas Oratorio.

The small English ARGO company have recently obtained rights for Bartok records; these will be something to watch for, as the entire engineering is done by Bela Bartok's son Peter, who prides himself in using recording equipment flat to 18,000 cycles, and does not extend the playing-time of a 12in side beyond 16 minutes.

The technical side has received prominence from a number of companies in their advertisements; thus, we read that Esoteric Records (who issue folk music and rare madrigals and the like) are using the Telefunken microphone and Ampex tape equipment. Classic Editions offer an organ work of Marcel Dupre with a response from 16-16,000 cycles. Urania, who have about 40 operas on LP, also use the Telefunken Condenser microphone, with a 30in/sec Magnetofon Tape and the Western Electric feedback cutter, the whole result being discs which, they state, are within 3db from 50-15,000 cycles.

BIG ISSUE

The transfer of rights to the American Columbia catalogue to Philips on the overseas market has had as its by-product the sale of Cetra-Soria records to Capitol, who have over 50 operas added to their repertoire in one fell swoop. These will have a tremendous impact on the English market if released by Decca along with the other American Capitols we have seen.

New issues in England reached a peak last September, when over 70 LP's appeared. We have much to look forward to in Australia in this regard, as we have not yet seen the Decca Medium-Play 33's, or the HMV, Columbia and Parlophone 45's. The local Capitol 45 of the Gayaneh Ballet is a pointer to what may be expected in the presentation of the shorter works.

It is interesting to note that EMI have made no attempt to issue concertos, symphonies, &c., on 45 in England, although the American catalogues abound with this sort of thing; nor have Decca released any 45's in England; their Gilbert and Sullivan series, the complete Fledermaus, and some Mantovani discs and others are all on both 45 and LP on the Decca American lists.

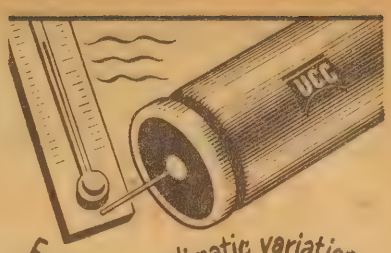
OFF THE RECORD

(Continued from Page 95)

But in no sense are these records merely seasonal productions. They are musically unique in my remembrance, and are virtually a symposium of carol singing, many of which were new to me.

SCHUBERT — Four Impromptus, opus 90 (C minor, E flat major, G flat major, A flat major), played by Artur Schnabel, HMV, BLP 1007.

This is almost certainly a 78 dubbing, but don't let that influence you, for you are unlikely to hear Schubert played like this for many a long day. Music and the phonograph owe much to this amazing perfectionist who would play only music by those composers whom he felt he could master. Fortunately, Schubert was one of them. Schnabel plays the music without the slightest affectation, sentimentalism, and with utter sincerity. Few pianists have ever achieved the role of interpreter as well as Schnabel. He is the complete servant of the composer, the music, and the listener, and his greatness flows from these things.



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SHORT-WAVE NOTES BY ART CUSHEN

BBC CELEBRATES TWENTY-ONE YEARS

The British Broadcasting Corporation has completed its twenty-first year of operation to a global audience. It is probably the best known service of its kind in the world.

THE British Broadcasting Corporation's Empire service was launched on December 19, 1932, with broadcasts directed to Australasia, India, Africa and Canada.

The purpose of the original Empire Service of the BBC was to provide an English speaking service which would bring broadcasting to colonial areas where the local services were undeveloped, to provide some direct listening to Great Britain in the Dominions, and to enable the BBC to collaborate with Dominion broadcasting organisations.

SERVICE EXTENDED

In 1936 it was found that most countries were broadcasting a shortwave service in other languages, and so the BBC soon afterwards commenced an Arabic service to the Middle East and Spanish and Portuguese to Latin America. Following the Munich crisis in 1938 German, French and Italian broadcasts were added.

When the war came, the European service was greatly expanded, till in 1942, 10 years after the BBC commenced shortwave operations, the languages had risen from the original English, to more than 50 languages and with a staff of more than 4000 engaged. Some 40 high-powered transmitters were then in service.

The BBC's "V for Victory" campaign stirred the Underground of Europe, and the broadcasts supplied much of the information to the Underground Press of Europe. The Empire service became the General Overseas Service, stepped up to 24 hours a day operation for English listeners throughout the world, with a special section for the forces.

POSTWAR BROADCASTING

The BBC had now reduced the number of languages broadcast to 44, but even so, some 80 hours a day are devoted to these broadcasts, an average of more than 120 news broadcasts are carried, while some 90 short-wave frequencies are employed by the transmitters.

Transmitter hours total more than 550 daily, and with the jamming at present experienced, relay stations in Europe and the Far East have been added to ensure better reception in the target areas.

Th BBC transmitters in Malaya were put into operation in 1951, and provide Australasian listeners with good signals throughout the year, when in winter, reception at night from London direct, would not be possible.

REPORTS APPRECIATED

Though the BBC does not confirm listeners' reports, they do appreciate letters from listeners concerning reception, and comments on the programs. These should be addressed to the Overseas Services, British Broadcasting Corporation, London W1, England.

MISSIONARY BROADCASTERS

THOUGH there are many broadcasting stations now in operation, here is news concerning the two leaders in this field, HCJB in Quito, Ecuador and DZAS in Manila, Philippines.

These stations are increasing in transmitters and power, and provide good coverage for listeners in this area. HCJB's present schedule for the new transmitters, which are located at Pifo, outside Quito, shows that 24-hour-a-day operation is maintained.

The new curtain antennae array at Pifo are under construction, the South Pacific one should soon be in operation, the North-South beam has been in service for some weeks, reports Ken Boord, of RTVN. Schedule is: 6050Kc, 8.40-3 pm; 9745Kc, 5 am-3 am; 11915Kc, 10 am-midnight; 15115Kc, 3 am-1 am; and 17890Kc, 3-10 am.

THE CALL OF THE ORIENT.—Well-known slogan of the Far East Broadcasting Company, Manila, which broadcasts missionary programs in many Far East languages, provides excellent signals during daylight hours on DZ16 17805Kc and DZH8 15300Kc. Complete schedule of the stations Overseas broadcast is 7 am-3 am on Sundays, and 7 am-4.45 pm, 6-3 am weekdays. These broadcasts are carried on DZH7 (9730) DZH9 (11855), DZH8 (15300), DZ16 (17805). The service for Phillippine listeners is carried on DZAS (680), DZB2 (3340) and DZH6 (6030).

NOTES for the next issue should reach 212 Earn St., Invercargill, New Zealand, by January 10, 1954.

ZYR78 Radio Bandeirantes, Rue Paulo Souza 181, Sao Paulo, Brazil, which we mentioned briefly last issue, has now been more fully identified. ZYR78 provides one of the best 25 metre signals during the afternoons to sign off at 3.30 pm, and the frequent use of the slogan makes identification easy.

The broadcasts originate from the B/C station PRK9, which operates on a 24-hour-a-day schedule. Two short-wave outlets, ZYR78, 11925Kc, which is the best received, relay the broadcasts, ZYR78, 7 pm-2 am, 9.30 am-3.30 pm, while ZYR77 on 6185Kc operates 7 pm-2 am, 7 am-3.30 pm. The programs are of a commercial nature, with frequent "singing" commercials. Chimes are heard each hour, and a lengthy sign-off announcement in Portuguese gives mention of the three station carrying the broadcasts.

The power of the stations isn't known, but as soon as verification is received, we will let readers know all about this interesting new station.

DX SESSIONS

SHORT-WAVE listeners throughout the world have come to look on the regular DX sessions broadcast by many of the leading short-wave stations of the world. as a means of fast communication when it comes to DX tips and information. Here is a list of the main sessions.

Location	Kilocycles	Time
Melbourne, Australia	15200	Sunday 2pm, 3.30pm.
Melbourne, Australia	9580	Sunday, 6.00pm.
Stockholm, Sweden	6065	Saturday, 5.20pm.
Brussels, Belgium.	6000	Thursday, 5.30am.
Berne, Switzerland	11865	1st Wednesday, 5.35, 7.20pm
Wellington, New Zealand.	11780	1st Tuesday, 7.20pm.

FROM THE MAILBAG

RADIO GAUGHA.—Station PRC-2 6135Kc has confirmed reception wi registered letter, and colored post This station was heard last winte sign off at 3 pm, with a special pro for foreign listeners. Radio Ga operates PRC-21 on 6135Kc, while W Radio Handbook lists PRC22 (9675), P (11865) and PRC24 (15115) also in the work, but inactive at present. All t stations operate with 7500w. The veri tion from PRC 1, is signed by Mari Soares Cunha, while the station is loc at Rue 12, de Octubro 16, Pum Minas Geraise, Brazil.

NOUMEA'S transmissions on 337 which were reported recently, cont to be received at good strength, the verification from the station st the transmitter is of 500w and was former broadcast band outlet on 150 which has been dropped in favor of new frequency.

The use by Suva and Noumea of tropical band, and its extensive use Indonesia, has meant that listeners u short-wave receivers not equipped cover the lower short-wave frequen are missing some interesting low po ed DX. Noumea's new schedule w is broadcast on both 6028Kc 1Kw 3275Kc 500w is, 5-6 am, 10 am-noon 8.30 pm, while news in French is sented at 5.30 am, 11 am, 6 pm.

RADIO FREE JAPAN.—Operated f inside communist China, has exten broadcasting operations, reports Japanese Short Wave Club.

Frequencies used for all transmiss are 1230Kc B/C, and 11896 10180 Broadcasts are 7.30-8 am, 1.30-2 pm, 8 9 pm, 9.30-10 pm, 10.45-11.15 pm, n night-10 am.

This is the only "freedom" station ported operating in the Far East, tho such stations are common in Eur one of the oldest which is still operat is Radio Espana Libre, a station wh was the outcome or the Spanish C War and which is still heard regula with broadcasts in Spanish which orig ate from the USSR.

DYH4, DUMAGUETE CITY, Phil pines, which for many years has b operating on 6055Kc with broadca from studios located on the campus Sillman University in that city, will sh ly commence tests on 3277Kc, states verification from the director, Mr. H. Bell. DYH4 is at present operating 8-1 pm on 840Kc (DYSR) and 6055Kc (DY The station is jointly operated by Philippine Federation of Christ Churches and the university. News broadcast at 8.10 pm, while at 9 pm Monday, Wednesday and Friday a f ther news broadcast is carried.

SUVA used **4880Kc** during a test early November with the post off transmitter, but station officials do disclose if this frequency will be brou into operation on a permanent nature, placing the present 5980Kcs outlet.

The ZJV3 transmitter still operates 3980Kcs.

HJKH RADIO SUTATENZA, at Su tenza, Colombia, which has been receiv with such strong signals in this area, continuing its usual Saturday eveni broadcast in English for listeners in N Zealand and Australia. The session w formerly 8.30 to 9 pm, but now appe to be from 8.50 pm. George Hughes, H tonton S.A. reports strong signals at location.

SYRIA'S BROADCASTING SERVI located at Damascus, is at present usi four short-waves and two broadcast ba transmitters . The short-wave schedu is as follows: Damascus, 3 20Kw, 6165 2-5 pm, 4.15-5.15 am, on 9555, 9.30- pm, 2-4 am, on 11695, 1.15-1.45 am, 11915, 6.30-8.30 am and 10 am-noo Damascus—4 7½ Kw, 7145Kc, 5-9.30 p 11 pm-6 am. Damascus—5 7½Kw, 6200Kc, pm, 9562Kc midnight-8 am. Damasc —6, 7½Kw, uses 6130Kc, 2-5 pm, 116 9.30-11 pm, 2-8 am, and 10 am to noo

THE HAM BANDS WITH BILL MOORE

BIG AMATEUR GATHERING AT WOY WOY FIELD DAY

Field Days are becoming increasingly popular events in Amateur Radio activity. They provide personal contacts for amateurs who have not met except over the ether.

HE NSW Division's 1953 Woy Woy Field Day held on November 15 tracted a crowd of well over 200, a milar total to the past three events. Amateurs and their families from Newsle and Sydney districts met in glorius weather to enjoy the extensive proram arranged. The only complaint oncerned the 50 mile car trip from ydney, which is becoming an increasg hazard each year. A number prohise to resort to rail transport next year. The following amateurs attended:—K2OF, 2YC, 2KZ, 2KF, 2BZ, 2SA, 2RU, JX, 2ART, 2LZ, 2AVK, 2AIK, 2ACD, DY, 2ABU, 2AL, 2AST, 2FA, 2VG, 2YL, DY, 2PQ, 2ZQ, 2VU, 2ANU, 2EL, 2AVG, HZ, 2AJQ, 2AJM, 2ABH, 2ADT, 2AJZ, PZ, 2AOR, 2XY, 2ARV, 2WJ, 2HL, APQ, 2IG, 2YR, 2IY, 2AAN, 2YB, 2ARF, AXZ, 2ASW, 2AOJ, 2ZC, 2DZ, 2XT, FP, 2VW, 2APJ, 2EO, 2LG, 2HE, 2HO, ASA, 2AAB, 2AGG, 2OT, 2OA, 2AEF, AML, 2BG, 2AZN, 2AYH, 2FM, 2KG, ABR, 2AGN, 2IV, 2AGW, 2VY, 2JT, AFM, 2AMP, 2YM, 2NX, 2AGD, 2AH, BO, 2AUB, 2KR, 2CS 2ID, 2AVO, 2AHY, MQ, 2ASE, 2AWQ, 2EH, 2IQ, 2GT, 2ZH, AEY.

44 Mc TRANSMITTER HUNT

The 144 MC transmitter search proved o be the most popular of the field vents, 17 parties competing. The transnitter was manned by Bill Rushby, K2ABR, and Es Griffiths, and positioned across the water from Woy Woy. First party to locate the transmitter as led by Geoff Partridge, VK2VU, of ingleton, time 20 minutes. In second lace was last year's winner, Maurice utler, VK2ANN, and party, from Sydey

The second field event, the "All Band Scramble", run over 45 minutes, was not so well supported.

The winner, Jack Hill, XK2ADT, scored well to register 16 contacts in the specified time. Ken Greenhaigh, VK2KG, and Ted Gabriel, VK2AVG, both recorded 14 contacts. Winners of the field events received suitable inscribed cups for their endeavors.

Other prizewinners were: Morse with QRM Test, 1st, Bruce Glassop, XK2BG 2nd, Jack Young, VK2OY.

Capacity check, 1st, Fred Bull, VK2AJM 2nd, Cliff Lamb, VK2LG.

The ladies' prizes were won by:—Quiz: 1st, Mrs. Baker (VK2FP); 2nd, Mrs Fisher (VK2DY). Musical Quiz: 1st. Mrs. Luckman (VK2JT); 2nd, Mrs. Hay (VK2AGW). Other prizes were presented for lucky numbers, raffles, &c.

PRIZEGIVING

The official portion of the program conducted at the close of the day covered the presenting of prizes by Hunter Branch President Johnny Clarke, VK2DZ. State President Jim Corbin, VK2YC, presided.

Local amateurs, Major Collett, VK2RU, Johnny Walker, VK2GA, and Mr. and Mrs. Cess Hardman, VK2KR, deserve special mention for their work in preparing for the event.

Dave Duff, VK2EO, and Jim Cowan, VK2ZC, were responsible for the preparation and conducting of the various competitions.

Woy Woy Field Days are major events in NSW amateur radio affairs, the venue half way between Sydney and Newcastle attracts the maximum possible attendance.

ARRL HOLDS EMERGENCY TEST

The ARRL conducted during October ne annual simulated emergency test try out the effectiveness of their mergency communications facilities.

Run in conjunction with Red Cross nd Civil Defence authorities, Red Cross mateur radio stations were operating n the calling and emergency frequencies The local Emergency Co-ordinator in ne various localities declared a surprise lert, and local nets then swung into ction.

The EC was responsible for the genral organisation, the originating of messge to ARRL Headquarters giving deails of the stations participating and raffic handled, and finally to forward a orm reviewing the complete test.

These tests provide two major feares, the first to give an accurate ssessment of the work of the net, and econdly to demonstrate to the public ne value of radio amateur operation the emergency field.

Last year 3012 stations participated, ncluding 1553 mobile and portable outts, and 2416 stations operating on emerency power. It is anticipated that hen totals are tallied in this latest est, that entries will be in excess of ast year's totals.

HF IN BRITAIN

There appears to be a possibility that ritish amateurs may lose portion of heir 420-460 MC/S band to Land Mobile ervices (Business Radio).

This follows on information contained in a letter passed between the GPO nd the Civil Aviation authorities. The PO asked the CA Department to check n possible interference from Business adio Stations operating on these frequencies to radio altimeter operation.

The RSGB is particularly concerned with the suggestion, and have pointed out to the GPO that under frequency allocation agreements of Atlantic City, the band was exclusively granted in Region 1 for Aeradio Navagational and Amateur Services. They stated, too, that the granting of use of these frequencies for any other service would be a contravention of the convention's decision.

British amateurs at the moment are not permitted to use the 50 KC section of the 3.5 MC band 3635 to 3685 KC/S. The RSGB recently pointed out to the GPO that the UK is the only important administration withholding this facility.

ROSS A HULL CONTEST.

The WIA's Ross. A. Hull Memorial VHF contest conducted annually during the 50 MC/S DX season is just concluded Participants are reminded that logs are due not later than February 24 and should be addressed to the WIA Federal Contest Committee, Box 1734, GPO, Sydney.

The outright winner within the Commonwealth will receive an appropriately inscribed certificate, and in addition, if a financial member of the WIA, will hold the Ross. A. Hull Memorial Trophy for one year.

The highest scorer in each call area in Australia and New Zealand will be awarded a certificate.

Additional certificates may be granted at the discretion of the contest committee.

In the two years mid-1951 to mid-1953, only 59 endorsements on WAC Certificates for 3.5 MC working were made by the IARU.

OVERSEAS QSL BUREAUX

QSL cards for overseas amateurs can be forwarded through the National QSL Bureaux of the various countries as listed hereunder. USA and Territories Bureaux are listed separately. Cards for British countries not listed can be sent via the RSGB Bureau, and for other countries not listed to ARRL Headquarters, 38 La Salle Rd., West Hartford, Connecticut.

Algeria: Via REF, France.

Argentina:: RCA, Avenida Libertador General San Martin 1850, Buenos Aires.

Austria: Via ARRL.

Azores: Via Portugal.

Bahamas: C. N. Albury, Telecommunication Dept., Nassau.

Barbados:: VP6NX, Wood Goddard, Bromley, Welches, Christ Ch.

Belgian Congo: PO Box 271, Leopoldville.

Belgium: UBA, Post Box 634, Brussels.

Bermuda: VP9D, James A. Mann, The Cut, St. Georges.

Bolivia: RCB, Casilla 2111, La Paz.

Brazil: LABRE, Caixa Postal 2353, Rio de Janerio.

British Guiana: Desmond Young, 22 Sussex St., Charlestown, Georgetown.

British Honduras: D. Hunter, Box 178, Belize.

Burma: BARS, PO Box 376, Rangoon.

Canton Island: Fred Carpenter, KB6AY, USPO 06-5000, Canton Island.

Ceylon: PO Box 907, Colombo.

Chile: Radio Club de Chile, Box 761, Santiago.

China: M. T. Young, PO Box 16, Taichung, Formosa.

Colombia: LCRA, Box 584, PO Bogota.

Cook Islands: Ray Holloway, PO Box 65, Rarotonga.

Costa Rica: Box 365, San Jose.

Cuba: Radio Club de Cuba, QSL. Bureau, Lealtad No. 660, Havana.

Cyprus: MD7XP, PO Box 451, Nicosia.

Czechoslovakia: CAV, PO Box 69, Prague 1.

Denmark: EDR, Box 79, Copenhagen K.

Dominica: VP2DC, Roseau.

East Africa: (VQI, 3, 4, 5), PO Box 1313, Nairobi, Kenya Colony.

Ecuador: Guayaquil Radio Club, Casilla 784, Guayaquil.

Eire: IRTS, QSL Bureau c/- EI5Z, 23 Orwell Gardens, Rathgar, Dublin.

Fiji: S. H. Mayne, VR2AS, Victoria Parade, Suva.

Finland: SRAL, Box 306, Helsinki.

France: REF, 3 Avenue Hoche, Paris 8.

Germany: (DL2): QSL Bureau c/- Posts and Telecommunications, Wahnerheide, BAOR 19.

Germany: (DL4): DL4 QSL Bureau, APO 757 c/- P.M., New York.

Germany: (DL5): Via France.

Germany: Other than above prefixes, DARC, Post Box 99, Munich 27.

Gibraltar: E. D. Wills, ZB21, 9 Naval Hospital Road.

Great Britain: A. Milne, 29 Kechill Gardens, Hayes, Bromley, Kent.

Greece: C. Tavaniotis, 17a Bucharest St., Athens.

Greenland: APO 858, c/- P.M., New York.

Grenada: VP2GE, St. Georges.

Guam: GRAL, Box 145, Aganda, Guam, Marianas Islands.

Guantanomo Bay: KG4AD, Box 35Q, Navy 115, c/- FPO, New York.

Guatemala: Manuel Gomez de Leon, PO Box 12, Guatemala City.

Haiti: Roger Lanois, c/- RCA, PO Box A153, Port-au-Prince.

Hongkong: Hongkong ARTS, PO Box 451, Hongkong.

Hungary: HSRL, Post Box 185, Budapest 4.

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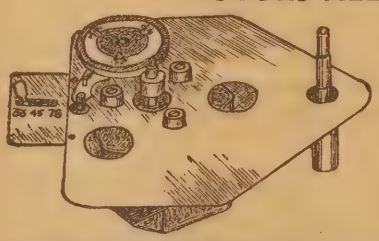

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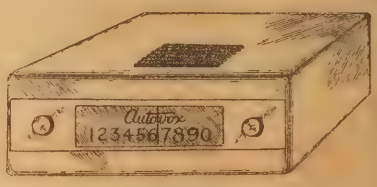

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India: ARC India, PO Box 6666, Bombay 20.
Indonesia: PARI, PO Box 222, Surabaya, Java.
Israel: IARC, PO Box 4099, Tel-Aviv.
Italy: ARI, Via San Paolo 10, Milan.
Jamaica: Thomas Meyers, 122 Tower St., Kingston.
Japan: (JA) JARL, 3-5 Kanda Ogawanichi, Chiyoda, Tokyo.
Japan: (KA) FEARL, APO 500 c/o PM, San Francisco.
Kuwait: Doug Taylor, VT1AC, Box 54, Kuwait, Persian Gulf
Lebanon: RAL, BP 1202, Beyrouth.
Libya: See Tripolitania.
Luxembourg: G. Berger, 40 rue Trevires, Luxembourg.
Macoa: Via Hongkong.
Madeira. Alberto C. de Oliviera, CT3AA, Beco Chao de Loba 4, Funchai.
Malaya: C E. Salton, Postal Services Department, Johore.
Malta: R. F. Jalea, 20 Collegaite St., Birkirkara.
Mauritius: V. de Robillard, Box 155, Port Louis.
Mexico: LMRE, Apartado Postal 907, Mexico DF.
Montserrat: VP2MY, Plymouth.
Morocco: G. Gragier, Box 50, Casablanca.
Morocco (Tangier Zone): EKIMD, Box 57, British Post Office, Tangier.
Mozambique: Liga dos Radio Emissores, PO Box 812, Lourenco Marques.
Netherlands: VERON, Post box 400, Rotterdam.
Netherlands Antilles: Suffisant T-24-1, Curacao
Netherland East Indies: Hr. C. Loze, PK1LZ, Burg Kuhrweg, 47 Bandoeng, Java.
Newfoundland: NARA, Box 660, St Johns
New Zealand: NZART, PO Box 489 Wellington C1.
Nicaragua: L. B Satres, Bolivar Av., 106 Managua.
Northern Rhodesia: NRARS, PO Box 332, Kitwe.
Norway: NRRL, PO Box 898, Oslo
Pakistan: PO Box 416, Lahore.
Panama: LPRA, PO Box 1616 Panama
Paraguay: RCP PO Box 512 Asuncion
Peru: RCP, Box 538, Lima
Philippine Islands: Philippine Amateur Radio Association, 931 R, Hidalgo St. Quiapo, Manila.
Poland: Polski Zwizek Krotkofalowcow PO Box 320, Warsaw
Portugal: REP, Travessa NOVA de S Domingos, 34-1, Lisbon.
Roumania: ARER, PO Box 95, Bucharest.
Salvador: YS10, Apartado 329, San Salvador.
Thailand: Frank Speir (W6FUV), Saba Thai, 4th Mansion Raja Damnoen CW. Bangkok, Thailand.
Singapore: PO Box 176, Singapore, Malaya.
South Africa: SARL, PO Box 3037 Capetown.
Southern Rhodesia: RSSR, Box 2377 Salisbury.
Spain: URE, PO Box 220 Madrid
St. Vincent: VP2SA, Kingstown.
Sweden: SSA, Stockholm 4.
Switzerland: USKA, Post box 1203, St. Gallen.
Syria: PO Box 35, Damascus.
Trieste: MF2AA, Major M H. R. Carragher, HQVG Police.
Trinidad: John A Holford VP4TT, PO, Box 554, Port-of-Spain.
Tripolitania: Peter Keller, MT2DZ, PO Box 260, Tripoli.
Uruguay: RCU, Casilla 37, Montevideo
USSR: Central Radio Club, Post box N-88, Moscow
Venezuela: RCV, PO Box 2285, Caracas.
Virgin Islands: Richard Spenceley Box 403, St. Thomas.
Yugoslavia: SAJ, Post Box 48, Belgrade.

A list covering Bureaux in the USA and its territories will be listed next month.

YOUR OPPORTUNITY

to join the world-wide ranks of amateur transmitters! The Wireless Institute of Australia holds regular classes in Sydney to assist Sydney and suburban enthusiasts to obtain their Amateur Operator Certificates of Proficiency.
Write for particulars to the Class Manager, W.I.A., Box 1734, G.P.O., Sydney.

YOU DON'T BUY A TAPE DECK EVERY DAY

THE purchase of a Tape Deck is a major investment and with so many brands on the market it simply does not pay to select anything but a recognised and proven Deck.
The Elmec Type E53 is just such a unit Designed by an experienced English Designer and manufactured in a well-equipped Australian workshop by skilled Tradesmen only

NOTE THESE OUTSTANDING FEATURES . . .

Two speeds 3¾ inches/sec and 7½ inches/sec Separate Capstan and Rewind motors Lightweight, under 8½lbs Simplicity of operation with single knob control. Automatic Tape lift on Rewind Adjustable Tape Dampers and Brake pads. Very low hum pick-up from motors Available with or without Heads With Heads Deck is ready to connect to an amplifier. Finished in an attractive Brown or Blue Hammertone

Tape Deck Type E53.

BARGAIN CORNER

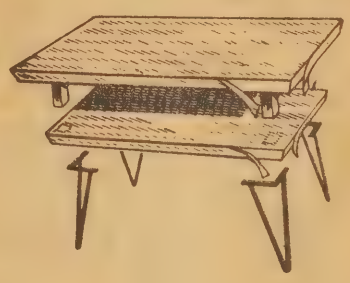
Now available a limited stock of Elmec High Impedance Half-track Record and Erase Heads, made to a manufacturer's specifications and now surplus stock. Ideal for Home Constructors. Fully Guaranteed,
Price £3/19/- each.
Available direct only.
Clip on Tape Guides to suit above. **Price 11/3**
Oscillator Coils to match. **Price 18/6**

Phone, call or send a stamped self-addressed envelope for further details to

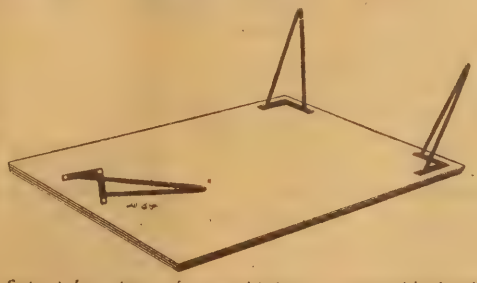
ELMEC 60 FERRIS ST., ANNANDALE, SYDNEY. PHONE LM4208.

All Elmec parts available from Magnetic Sound Industries, 385 George St., Sydney

Ereleg IRON LEGS



FOR EASY USE BY EVERY HANDYMAN . . .



Set of four legs of wrought iron, painted black will make sleek and modern practical furniture. Screws included at prices shown.
Choose from 4 sizes

28in Desk or Dining table. Four for 43/10
17in Bench or Cocktail table size. Four for .. 35/8
13in Coffee table size. Four for 29/-
6in Couch or sofa size. Four for 21/-

. AND IT TAKES BUT A FEW MINUTES TO TRANSFORM A FLUSH DOOR OR A SHEET OF PLYWOOD INTO A HANDSOMELY MODERN TABLE, DESK, COCKTAIL TABLE OR BEDSIDE TABLE.

AND YOU ONLY NEED A SCREWDRIVER.

UNA MANUFACTURING CO.
Box 1915 G.P.O., Sydney

MAIL THIS COUPON TODAY!

Please send me a set of . . . . size legs. I enclose here cheque, money order of. . . . value

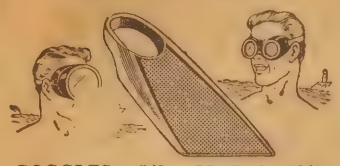
NAME .....

ADDRESS .....

SURPLUS

512 Elizabeth St., Melbourne, C.1.
'Phone: FJ5904. Just 4 doors
Mail Orders Carefully Packed
Please Add Freight or Postage

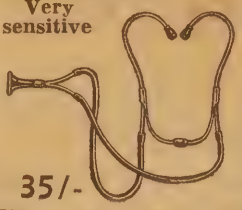
UNDERWATER SWIMMING AIDS AS USED BY ARMY FROGMEN



GOGGLES, 15/6; MASKS, 16/11. Fins, Large size, 8-10, 32/6; Med. size, 6 to 8, 32/6; Small size, 3-5 and 1 to 3, 24/6; Junior size, 18/6.

MECHANICS' STETHOSCOPES, Ideal for Testing Engines.

Very sensitive



35/-

73/6

Complete with flex and switch.

At last! The spotlight you have been waiting for.

Fitted with genuine American sealed beam 6-volt globes. No motorist or boat owner should be without one.

Ideal for Fox or Rabbit Shooting.

ARMY SPOTTING TELESCOPES

Many uses on the farm. Ideal for sheep spotting.

Useful on the rifle range, 3 draw 17in long 6½in closed 1in object lens, 18 magnification made in England. . . . **£7/19/6**

SPECIAL DISPOSALS METER OFFER.

0-10 amp meters, AC-DC, 2½in dial,	45/-
0-1 milliamp, 2½in dial	37/6
Weston 0-50 volt 0-100 amps combined M/coil,	£3/10/-
English 50-0-50 Ammeters, M/Coil	37/6
English 20-0-20 Ammeters, M/coil	37/6
English 0-20 Voltmeters, M/coil	25/-
English 0-40 Voltmeter, M/coil	25/-
English 0-300 AC-DC Voltmeters	55/-
English 0-5 Milliammeters, 2½in	27/6
English 0-150 Milliammeters, 2½in	30/-
English 0-25 Ammeters, 2½in, M/c	30/-
English 0-10 Ammeters, 2½in dial, Moving Coil	45/-
English 0-30 Voltmeters, 2½in dial AC-DC	42/-
Eng. 0-40 Ammeters, 2½in dial AC-DC	42/-
English 0-50 Ammeters, AC-DC	42/-
Eng. 0-3 Ammeters 2½ dial, AC-DC	45/-
Eng. 0-150 Voltmeter, 3in Dial, Moving Coil	39/6
Eng. 0-500 Micro Ammeter M/coil	37/6
Eng. 0-150 Ammeters, 3½ Dial, AC-DC	75/-
Eng. 0-20 amps, 2in Dial, M/c	25/-
Eng. 0-1½ Milliamps, 2in Dial, M/c	19/6
Eng. 0-20 Milliamps, 2½ dial, AC-DC	17/6
Eng. Multimeter, reads ohms and volts	35/-

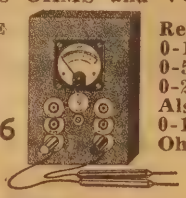
Battery Charging Generators. Ideal for Home Lighting Plants.

12-volt, 500 watt, in good working order £5
12-volt, 500-watt, new £7/10/-
24-volt, 1000-watt. Brand new . £12/10/-

AIR MIN. MULTI TESTER TESTS OHMS and VOLTS

COMPLETE WITH TEST PRODS

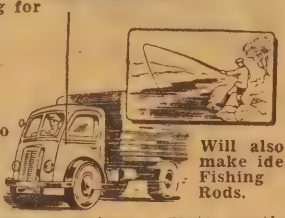
£5/17/6



Reads 0-10 Volts, 0-50 Volts, 0-250 Volts Also 0-10,000 Ohms.

STEEL ARMY TANK AERIAL RODS. WILL MAKE IDEAL RADIO AERIALS FOR CAR OR TRUCKS

Too long for postage. Advise nearest railway station.



Base to suit Aerial, 9/6 each.

Will also make ideal Fishing Rods.

12ft long, 3 sections. Each section 4ft, 22/6. 8ft long, 2 sections, 15/-.

AMERICAN ELGIN 8-DAY AIRCRAFT CLOCKS.

FIT TO YOUR CAR OR TRUCK.

£5/5/-

The name of Elgin is world renowned and made by the best manufacturer in America.

GENUINE AMERICAN KLAXON HAND-OPERATED HORNS

Very Loud. Ideal for Factories, Trucks, Boats, etc.

Useful for Timekeepers. Brand New, £4/4/-.

WATCHMAKERS AND INSTRUMENT MAKERS

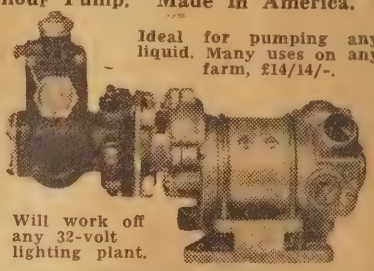
English Tweezers . . . . . 6/6 and 5/6
Eyeglasses . . . . . 6/6 and 8/6
Extra strong double lens Eyeglasses, 15/-
SCREWDRIVERS, set of 5 . . . . . 13/9

NEW YEAR SPECIAL OFFER FOR MOTORIST

17/6 17/6

2 genuine American Herbrand spanners, ¾ x 7-8, 1 1-16 x 15-16. 1 pair English diagonal cutters. 1 screwdriver.

Lucky Repurchase! Aircraft 24 volt Motor complete with 400 gal. per hour Pump. Made in America.



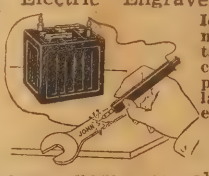
Ideal for pumping any liquid. Many uses on any farm, £14/14/-.

Will work off any 32-volt lighting plant.

Pump only, 70/-. Brand new, 70/-. In good working order.

ELECTRIC ENGRAVER

What everybody has been waiting for. An Electric Engraver that works off your car battery.



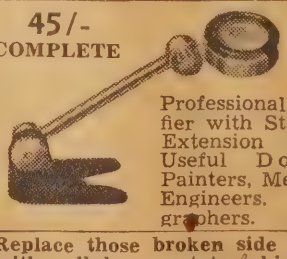
Ideal for name tags, dog collars. plant labels, etc.

Engraves anything in metal.

29/6

Engrave your name on all your tools. Marked tools are never stolen. No Garage should be without one.

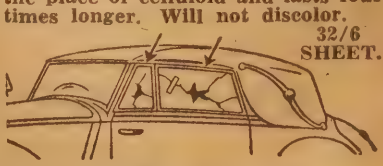
45/- COMPLETE



Professional Magnifier with Stand and Extension Arm. Useful Doctors, Painters, Mechanics, Engineers. Photographers.

Replace those broken side curtains with cellulose acetate which takes the place of celluloid and lasts four times longer. Will not discolor.

32/6 SHEET.



Non-inflammable acetate sheet is recommended for all types of side curtain. Sheets are 20 thousandths of 1 inch thick. Size of sheet, 24in x 52in. Can be sewn or cemented into frames.

STORES

512 Elizabeth St., Melbourne, C.1.
om Victoria Street. 'Phone FJ5904
nd Efficiently Despatched
Include State in Address

RAF Leather Flying Helmets, 35/- Speaking Tubes, 50/-, RAF MK8 Goggles, 48/6, MK7, 37/6, Flying Boots, wool lined, £5/15/- pair, Stock and Die sets, ⅛in, ¼in and 1in water pipe, £4/19/6. Special Offer: Small One-man Rubber Boats, ideal for spear-fishing, £6/4/6.

SPECIAL OFFERS

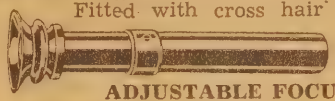
Generator Test Meters, 35-0-35 amp meters, 4½in dial, 45/-; 0-10 volt meters, 4½in dial, 45/-. Loading Resistors can be supplied to make meter read 10.20 at 12/6. Medical Scalpels, many uses, photographers, etc., 6/6. Shaded Pole induction Motors, made by Hoover of England, 230 volts, AC. Ideal for Projectors, Tape Recorders, Fans etc., £4/19/6. Inspection Mirrors, ideal for Mechanics, 5/9. Tapper Transformers, 6, 12, 18 and 24 volts, 3 amps, 39/6. 230 volts input. Low pressure Spray Guns, 39/6. Army Steel Tow Ropes with looped ends. 17/6. Army Tripods for photographic work, levels, etc., 41in long, 22/6. SAE or Whitworth Spanners Sets, open one end, ring the other, 25/-, 6 spanners to set. English Hair Clippers, first-grade quality, 17/6 pr. SAE open end Spanners, 6 to set, 24/6. Whitworth, 4 to set, 18/6. 2½in Paint Brushes set in rubber, special price 10/6. Brand new 7-8in Spark Plugs, suit most old type cars, 2/6 ea. Brand new RAAF Life Jackets, kapok filled, 27/6. 4in Calipers, inside and outside, 5/6. Parabolic, Reflector Mirrors, 3½in, 15/-. 10½in, 39/6. Build yourself a spotlight or for photographic work. Bosch Electric Windscreen Wipers, £4/18/6. Steel Tool Boxes, complete with lift-out tray, 32/6. Best quality English Carpenters' Saws: 4, 5 6, 7, 8 and 10 point. 30/-. Swiss Music Box Units, can be fitted into any box. Make yourself a Music Box, 30/-. Many tunes available, including The Harry Lime Theme, The Merry Widow, One Enchanted Evening, etc.

Kelvin rubber knee boots 42/6
Army slouch hats, all sizes 22/6
American type G.I. caps .. 7/6
Khaki berets, leather bound 5/9
Water Bottles, complete .. 4/6
Best quality bib and brace overalls, navy or khaki 29/11 pr.
Boiler suits, navy or khaki, 51/6
American gaiters .. .. .. 3/6 pr.
Australian gaiters .. .. 5/6 pr.
All wool khaki socks .. 7/6 pr.
All wool army blankets .. 37/6
Heavy duty army boots 39/6 pr.
Jungle green herringbone self-support trousers 39/6 pr.
Army jungle green shirts 23/6
Khaki shirts 22/6
Army great coats 50/-

IN FIRST-CLASS ORDER. DALTON COMPUTERS. IDEAL FOR AERO CLUB, A.T.C., etc. 45/-.

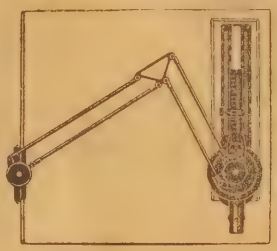
ARMY FOCUSING TELESCOPE

Easily converted for use on dumpy levels.
Can be used as a rifle sight.
Excellent magnification .. £4/19/6
Fitted with cross hair



ADJUSTABLE FOCUS

R.A.F. PLOTTING BOARD WITH ARM



Bakelite Base. Draws Angles Parallel or Vertical

70/-

IDEAL FOR ENGINEERS, STUDENTS, ETC.

LUCKY PURCHASE OF INFLATABLE RUBBER AIR BEDS

Ideal for Caravans, Cars, etc. Ideal for Hikers.

Take one to the beach. Will float in water, £5/11/6.

English Motor and Blower, 24 volts

Will work off any Lighting Plant.

39/6

Larger size also available that will work off 12 or 24 volts, £3/15/-.

AMERICAN VACUUM or AIR PUMP

Builds up air pressure to 20lb at 1000 R.P.M. develops up to 120lb of hydraulic pressure; will pump 7½ gallons S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems. £3/15/-

24-volt motor and hydraulic pump, capacity 3½ gals. per minute £3/15/- Automatic actuators with 24-volt motor geared with telescopic shaft 400 r.p.m., can be used as fence post borer, etc., 55/-. Hydraulic pumps, 1200 p.s.i., 8 1-3 gal. per min., £18/18/-. 5 gal. per min., £7/10/-.

ENGLISH ARMY SPOTLIGHTS

IDEAL FOR SHOOTING. FIT ONE TO YOUR CAR.

6-volt 37/6 12-volt 25/-
Fitted with Mirror Reflector.

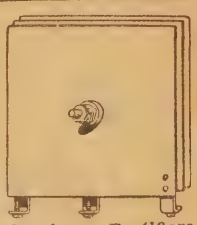
BRAND NEW LEVER TYPE GREASE GUNS. WORTH £4/19/6.

59/6

Ideal for all types of trucks, tractors or cars. 7500lb pressure.

BRAND NEW ENGLISH RECTIFIERS.

Make yourself a Battery Charger.
12v. 2 amp. 35/-
6v. 5 amp. 50/-
12v. 5 amp. 79/6
12v. 3 amp. 45/-
6v. 2 amp. 24/6
6v. 4 amp. 45/-



Transformers to suit above Rectifiers, 2 amp, 37/6; 6 volt, 5 amp, 45/-; 12 volt, 5 amp, 55/-.

SPRAY YOUR CAR, TOYS, HOBBIES, FURNITURE

52/6

Spray from Your Spare Tyre.

An Ideal Tool for touching up damaged paintwork. Will spray Lacquer, Paint, Enamel.

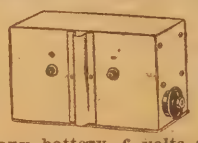
Brand new AEROPLANE WHEELS

IDEAL FOR WHEELBARROWS, HAND-TRUCKS, TRAILERS, Etc.

10½in x 4½in, £4/15/-, complete with tube.

COMPLETE BATTERY CHARGER

Fitted with Brand New English Selenium Rectifier.



Works off 230v. Household supply.

Charges any battery, 6 volts at 4 amps. £6/15/- complete. Also available, 6 or 12 volt Chargers combined. Charge 2 amps, £7/15/-. Brand new 6 volt, 2 amp Chargers, complete, £5/2/6.

24-VOLT MOTOR COMPLETE With Fuel Pump

Ideal for Caravans. Takes the place of Hand Pumps. £5 each.

Many uses on the Farm. Will transfer Petrol or any Liquid from Drums, etc. Will work from 24 or 32 volts, AC or DC.

A.E. RADIO

Amplification Communication Electronics

PHONE: LA 3845

136 VICTORIA RD. MARRICKVILLE, SYDNEY, N.S.W

EVENINGS and WEEKENDS: "KALUA," COLLAROY ST., COLLAROY—XW5956
DULWICH HILL, UNDERCLIFFE, EARLWOOD TRAM AT DOOR. STOP No. 42.

AR8 Communications Receiver

6-band 140 to 20 megs 11 valve. Standard octal series.
Complete with valves and circuit.

£23-17-6

Completely converted for 240v. A.C. operation including power supply, speaker & speaker cabinet.

£34-17-6

Heavy Duty Potted Transformers

265x265	250MA	£2/5/-
365x365	150MA	£2/5/-
1500v. CRO transformer		£2/5/-
150 M.A.Filter choke		£1/2/6
100 M.A. Filter choke		10/-
60 M.A. Filter choke		10/-

New Coils & Intermediates standard or miniature to suit all valves.

Coils B/C 455 KC	7/6
Coils S/W 455KC	7/6
Inters	9/6
Loop aerial coils	7/6
BFO units & 1500 KC IFs	12/6

NEW

English V.H.F. Transmitter Receiver

150 to 180 Meg. 14 valve including plugs & Photostat of circuit **£4-17-6**

SCR 522 Transceiver new condition 17 valve 100 to 150 megs including Photostat of circuit **£24-10-0**

NEW TELEPHONE WIRE

American 7 Strand Rubber Insulated
½ MILE DRUMS. **£1-15-0**
CASE OF 6 DRUMS, 3 MILE, **£10/-/-**

TAPE RECORDER MOTORS

New Collaro 4 Pole 240V or 110V A.C. Motors **£2-12-6**
New Collaro Pickups Magnetic Plug-in Head With Stop and Turntable **12-6**
Complete Gramo Player Unit **£2-18-6**

CLASS C WAVE METERS

Tested. Good Order
£10-10-0

GENEMOTOR OF MANY USES

Converts to 1/6th H.P. AC motor drives as 6v. 20 amp or 12v. 13 amp. generator converts to A.C. rotary convertor **£2-17-6**

New American Indicator Units

For that C.R.O. complete with valves **£9-17-6**

VHF RECEIVER AR2

230 to 258 megs, 11 valve 2 6AK5, 8 9001, 1 12A6
Small, light, makes ideal mobile unit.
New condition. **£7/17/6**

RADIO ALTIMETER

15 valve V.H.F. transmitter receiver latest octal & acorn valves. Ideal for mobile rig or P.A. purposes
New condition **£8/17/6**

Co-ax. Twin Cable, 20ft Lengths	8/-
Throat Mikes, New	3/6
Mike Transformers	4/6
12v 420 Watt Prefocus Globes	7/6
Multi-Core, 7-core	1/- yd.
100 yds	£2/17/6
Multi-Core, 5-core	1/- yd.
100 yds	£2/17/6
Changeover Relay, D.P.D.T. Shielded	18/6
101 or F.S.6 7-Pin Plugs & Cables	7/6
200 Ohm Relays	5/6
10,000 Ohm Relays	12/6
12 v 50 amp Contacters	10/-
FN Midget 2 Gang Condensers	6/9
AWA 6V Gasfilled Vibrators	15/-
Octal Sockets Doz.	5/-
Hydrometers. Battery Testers	5/9
Torches 2 Cell Focusing	9/9
Torches, 3 Cell Focusing	6/9
Shielded Hook-up Wire, 10 yds	5/6

RESISTORS

New famous maker
100 ASSORTED
over 30 values
50 1 watt, 25 ½ watt, 25 ¼ watt
12/6

Command Transmitters

Transmitters & receivers complete with valves
£6/17/6 ea.

HI Power Genemotors

6.v—500v. 160 M.A.
£6/10/-

NEW VALVES

5Y3	10/-	9004	10/-
EZ82-6V4	10/-	6V6	12/6
6X5	10/-	6SK7	12/6
7193	7/6	6SQ7	12/6
6H6	7/6	6SA7	12/6
6SH7	7/6	6J8	17/6
813	£3	6U7	12/6
807	£1	954	10/-
12SH7	7/6	1625	£1
12A6	12/6	1626	10/-
12SL7	12/6	1629	10/-
12SJ7	12/6	843	£1/10/-
12SK7	12/6	803	£3
9001	10/-	837	£1/1/-
6SN7	12/6	6J6	15/-
6C4	12/6	6AK5	15/-
6AG5	12/6	6AG7	15/-
6K7	9/6	807	20/-
6K5	3/6	866	20/-
VR65A	3/6	VR150/30	15/-
957	10/-	954	10/-

MAKING A REVOLVING LAMPSHADE

An easy project for your workshop which does not require many tools and provides considerable scope for your ingenuity.

BY L. W. TEWCRAGG

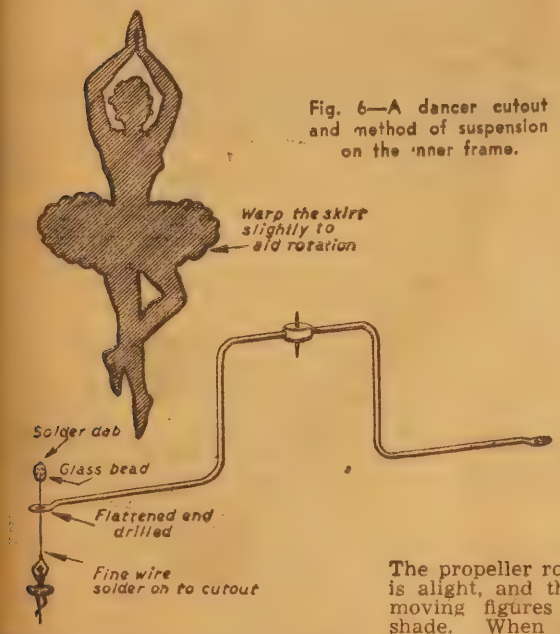


Fig. 6—A dancer cutout and method of suspension on the inner frame.

THESE shades for table lamps are a very attractive novelty and et very simple to construct. It s very seldom that we are able, o effectively and simply, to use nergy that usually goes to waste.

The principle of these shades is he same as the flickering fire effect n electric fires, and is accomplish- d by interposing a propeller, free o rotate between the bottom of the amp shade and above the electric amp. As the air in contact with ulb heats and rises, it strikes the ropeller and causes it to rotate. his is all that is required in an rtificial fire, for the shadow of he vanes produces the flickering ffect.

It is general practice to have two lectric lamps, each with its own anes, to obtain the best results. In sing this means in lampshades, the ropeller is made to carry arms to hich are attached small figures of irds, fish, ships or anything else ccording to personal preference.

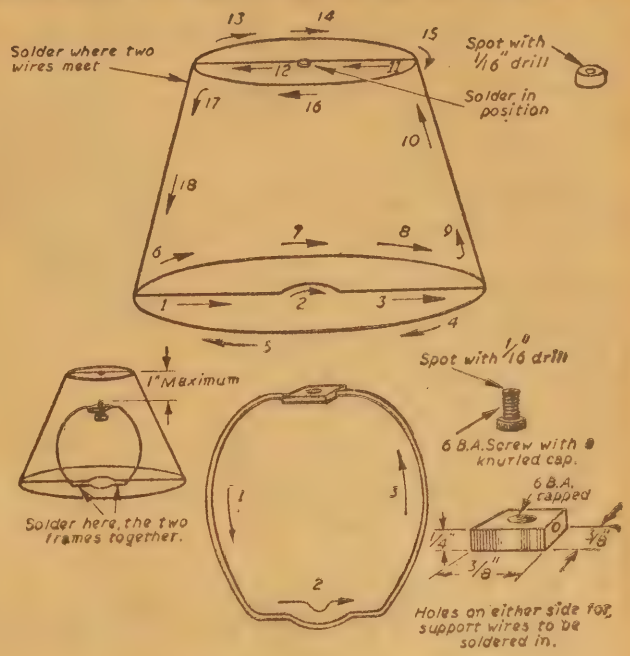

Solder where two wires meet
Spot with 1/16" drill
Solder in position
1" Maximum
Solder here, the two frames together.
Spot with 1/16" drill
6 B.A. Screw with 8 knurled cap.
6 B.A. tapped
Holes on either side for support wires to be soldered in.

Fig. 1—Details of the outer wire frame.

The propeller rotates when the lamp is alight, and the silhouettes of the moving figures are cast upon the shade. When the light is off the lamp appears to be fitted with an ordinary lampshade.

The main point is to balance the propeller and figures well; the bearings which support the vanes must be as frictionless as possible.

MATERIALS

The materials required are wire, 3-32in-1-8in dia. in brass, copper, or galvanised iron, and pieces of sheet brass tinplate, no thicker than can be cut with ease. The dimensions of the shades are not given here for there are so many sizes and these must be suited to individual requirements.

CONSTRUCTION

First make the outer frame in wire, working as Fig. 1, and following the arrows. The small half-circle is formed around a mandrel about 1in dia. For the large base circle it may be more difficult to find a suitable mandrel, so draw with compasses a circle the required size on paper, then bend the wire a little at a time around a smaller former, checking from time to time against the pattern.

When the outer frame is completely formed and the top bearing soldered into a central position as shown in Fig. 1, the inner frame is made by the same method, forming it first then soldering into it the tapped block (Fig. 7.). Now solder together the two frames as shown.

Next cut out the blank of the propeller. Drill the boss centrally and solder the spindle into position. This may be made from 1in of a darning needle, ground to a point each end, or of 1-16in dia. silver steel, if on hand. Into the boss beneath the vane fit the wires to carry the cut-out figures, bending them close to the inner frame, as shown in Fig. 2, so that the figures appear at the desired position on the lampshade.

This arrangement helps to obviate the shadow on the shade of the arms carrying the cutouts.

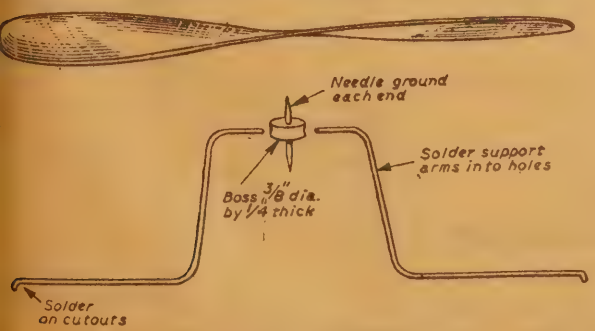


Fig. 2—The propeller and inner frame.

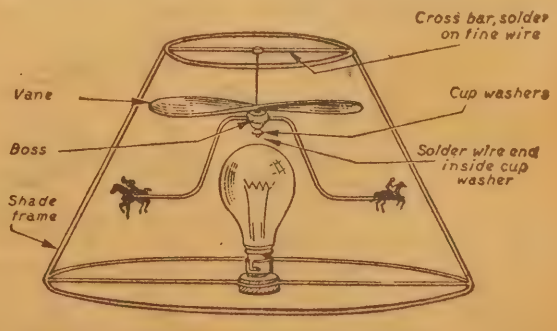


Fig. 3—Alternative form of suspension.

On the tips of the arm sweat the figures cut from sheet brass or tinplate. Now warp the propeller, one blade left hand, the other right hand, by about 30 degrees to a shape similar to an aeroplane propeller.

To balance the rotary, place the spindle in the cup of the 6 BA screw, but do not tighten it into the top cup, the balance should be good as it stands, but, if not, dab the the lighter arm with a spot of solder then file until a correct balance is found, remembering to do this job away from draughts. Screw up the thread until the spindle is just gripped between the cups. It should take no more effort to revolve the vane than a slight puff of breath.

ALTERNATIVE SUSPENSION

A simple form of suspension is by fine wire and cup-washers, the type used on rubber-powered model aircraft, see Fig. 3. This form is easily fitted into an existing shade. Across the top ring of the shade solder a cross-bar and on to this solder a fine wire, wound one turn around. First place on the vane an attached boss as Fig. 3, and then the two cup-washers, domes together. Curl the end of the suspension wire into the lower cup-washer and solder inside; it is now complete and ready for covering.

Fig. 4—Suggested designs for cutouts for which thin sheet brass or tinplate can b used.

The cut-out figures are ma from small pieces of sheet brass tinplate. Thin wire was used such details as the cabin of aeroplane or the rigging of ships. A few suggested desi are given, in Fig. 4. As an id of the scope of cut-outs, many m are available after a momen thought.

THE COVERING OF LAMPSHAD

This is usually accomplished sewing the shade material to wire frame with silk threads. Ta some brown paper and cut this fit the frame first, then use it a pattern for the chosen coveri

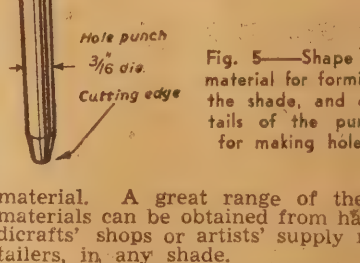


Fig. 5—Shape material for form the shade, and tails of the pu for making hole

material. A great range of the materials can be obtained from ha dicrafts' shops or artists' supply tailers, in any shade.

Make the joint on the shade ove lap by ¼in. Next required is series of holes punched around t edges of the material about 3-8 in depth and ¼in apart. Fig. 5 sho the material laid out flat, or dev oped, for the usual shaped sha To punch the holes a punch of t pliers type as used in leather wo is useful. If these are not ava able, take a piece of steel tube w a 3/32in-1/8in bore 3in long a grind the end to a cutting ed from the outer diameter to the inn diameter, see Fig. 5.

Place the material on a wood board and where a hole is requir

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ite the punch and strike it sharp-
with a hammer. Neat holes can
cut rapidly by this method. Pro-
d with the hole punching around
edge of the shade as shown in
. 5

ew into position on the frame
h needle and silk thread, by tak-
the thread through the material,
ind the frame, over the outer edge
into the hole, and so on, in a
d of over-stitch. The silk may
ended off by tying a decorative
t, or glueing the end to the in-
e of the shade and frame.

o finish the job the outside of
shade should be painted to har-
nise with the revolving figures.
fish have been chosen then a
sprigs of seaweed would look
y well on the shade or in the
e of the ships, paint the sea below
ir waterline. This is not really
icult: practise a little on scrap
er, until you obtain the desired
cts. Use good brushes and paints;
cial paints are marketed for this
rk, and are readily obtainable
m your local artists' suppliers.
his hand painting is definitely not
your line, cut out stencil plates,
m thin cardboard, and stencil on
pattern.

TATING FIGURES

An interesting idea for use with
se shades is to suspend cutout
ures on wires to rotate as they
n around within the shade As
wn in Fig. 6 a dancing girl fits
s role very well. The usual type
suspension from the vane is used,
the cutouts are themselves also
e to rotate on a glass bead used
a bearing. As they travel around
shade the silhouettes appear to
n on their toes, producing an ex-
tionally novel effect .

A word of warning here, as neces-
y as it is to have the cutouts
close to the inside of the shade
possible, on no account must they
ch, for the slightest contact will
se them to stop all movement.

Another variation on this theme is
nd if a square shade is made,
the cutouts made to traverse
ircle within the square, produc-
an effect where the figures
dually appear and disappear
n view as they approach or re-
e from the sides of the shade.

READER BUILT IT!

(Continued from Page 82)

narks on shunting apply. The
itude in the value of these com-
nents results from the number of
riable factors involved. A more
tentious set-up is not warranted
cases of this nature where the
ividual can experiment with what
ns are on hand to give results
table to the particular require-
nts.

The additional volume control on
speaker in the set allows the
ume control of the set to be ad-
ted to suit the requirements of
extensions while retaining con-
l on the volume from the set
aker. It will need to be a fairly
resistance potentiometer. Values
low as 6 ohms have been avail-
e on the market.

f the hearing aid point is desired
the set, the extension-line idea
be dispensed with and the head-
ones and volume control con-
ted directly to the set through the
mfd capacitors.

LET'S BUY AN ARGUMENT

(Continued from Page 45)

Look, a cathode follower! What a circuit! What a design. What a lot of &c.

Has it ever occurred to you that a cathode follower is a necessary evil? That all the stages in the amplifier are necessary evils? They all add their quota of distortion, small though it might be.

But let me explain what I mean, more logically and with fewer punctuation marks.

A cathode follower is an excellent device where it is necessary to feed the signal from a high impedance circuit into one of lower impedance. That's why we inserted one, in the wide range tuners, between the detector and the whistle filter.

That's why we've used them, too, for feeding signals through long cables, which would otherwise introduce high frequency loss. Hence their application to control heads and such like.

Yes, the cathode follower is a very useful and very effective means to an end, but it has no magical properties. Signals aren't the better for having passed through it, any more than through any other stage.

If the broadcast band weren't so tightly packed with stations, the R and H tuners would be better without the filter and without the cathode follower.

And the control heads would likewise be better if the long coupling lead were eliminated and the cathode follower which feeds it.

But, while the authorities license enough stations to make heterodyne whistles a problem, we know of no better way of getting rid of the said whistles than with a cathode follower and filter.

And, if record enthusiasts like to have long leads between the control head and the main amplifier, for social and technical reasons, then there's nothing better than a cathode follower to eliminate possible high frequency losses!

And so on.

But, here's the point: There is no virtue in putting a cathode follower into a circuit where its presence is not strictly required. It won't deteriorate the signal much, but it certainly won't improve it. And it represents another cluster of components which can go wrong.

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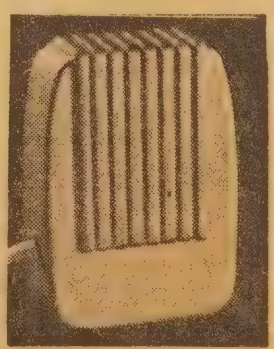

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ANSWERS TO CORRESPONDENTS

L.R.C. (Ayr, Nth. Qld.) inquires if we are planning anything new in the way of 32-volt receivers.

A. No doubt we will be describing more 32-volt receivers in the future but we cannot make any definite promises at the moment. Either of the receivers described so far should suit your purpose but the vibrator job would have a reserve of power for operation in large rooms, &c. As you suggest, the best plan may be to build a receiver to the vibrator circuit and obtain the high tension from a 28-volt genemotor. A dropping resistor could be placed in the primary circuit of the genemotor if necessary. There should be no difficulty with filtering and the arrangement should be more economical of parts than a separate amplifier and radio receiver. The only point about the separate radio is that it could be made more economical of primary current. This may or may not be a consideration, depending on your charging facilities.

E.C.L. (Malaya) is anxious to obtain some information about an army tranceiver Type ZC1, Mk. 1, New Zealand, and wants to know whether we can help him.

A. We are afraid we have been unable to locate any data on these units, E.C.L., and we can only suggest that some of our readers may be able to help. If so, they may care to contact you direct and we are, therefore, publishing your full name and address. Anyone who may be able to help should write direct to Mr. E. C. Lough, c/o Raub Aust. Gold Mine Ltd., Raub, Pahang, Malaya.

J.T.S. (Cooranbong, NSW) sends us a circuit of a three-valve battery-operated receiver which he has copied from an old book and wants to know whether it would be worth building and what values would be involved.

A. We would say it was a very old book, J.T.S., judging from the circuit style, and we can hardly recommend it as worth building. Modern circluits, even simple ones, are much more efficient than this type of thing and you would be better advised to start with something more modern. We have a number of simple circuits on our files which would be suitable and these can be obtained through our query service. Typical of these is the 1K5 series (May to September, inclusive, 1947), which commenced with a one-valve set and finished as a four-valve set.

R.W. (South Brisbane, Qld.) wants us to send him all particulars of the Ramble portable described in the October, 1953, issue of Radio and Hobbies, including the price of a kit of parts.

A. Sorry, R.W., but you seem to have things a little confused. As mentioned in these columns before and in the panel on this page, we do not deal in components and are, therefore, unable to quote prices for kits of parts. For this information you must contact some of our advertisers. We are not quite sure what you mean by full particulars of the set because all the necessary information was included in the original article. The only additional data available is the chassis blueprint (necessary only if you intend to cut out your own chassis) and the actual photographs which were mentioned in the article. We suggest that you contact some of our advertisers for a quote for the kit of parts and that when you obtain these (including a ready-made chassis) you will find that the instructions in the article are sufficient.

B.E. (Toowoomba, Qld.) asks if we have a circuit to suit some parts which he has on hand.

A. The one-valve regenerative receiver which was described as No. 5 of the "Teach Yourself Radio" series in the December, 1952, issue of Radio and Hobbies should suit your purpose. It uses a 3S4 valve and most of the other parts you list. The circuit and some other diagramatic information relating to this set are available through the 2/- query service. It should be possible to receive stations 300 miles or more distant on this receiver but its power output and gain are not sufficient for the operation of a speaker, even on local stations.

F.McL. (East Coburg, Vic.) asks us to explain a variable top-cut filter and also if a couple of back circuits are available.

A. A top-cut filter is a filter which attenuates everything above a given frequency. A variable top-cut filter is arranged so that the frequency at which the attenuation begins can be altered. The filter described in Radio and Hobbies was designed so that it could be switched in the voice coil circuit of a receiver or amplifier and adjusted to enable poor quality radio programs or worn records to be heard to best advantage. Circuits of the "Tom Thumb" and the "Baby Booster" circuits are available through the circuit query service. Details of the conditions of the service are given on these pages.

R.P. (Urbanville, NSW) has built the Jubilee Portable but is rather disappointed with the results and suspects that the IF transformers are in need of alignment.

A. The fact that the set is still operative without the shield cans certainly does indicates that the gain is lower than it should be, but it is not necessarily an indication that the IF transformers are to blame. The heterodynes you encounter in the other set are likewise not a definite indication of fault. However, it is most likely that the IF circuits is in need of adjustment if this has never been done since the exact adjustment is influenced by the valves of the set and is not likely to be exactly correct even if the transformers were correctly set when new. The best approach would be to obtain the services of a signal generator or have the work done by a professional serviceman. In the latter case it should be possible for the serviceman to advise whether the sensitivity is reasonable after the job is done and even to find the source of loss if there is one. Regarding the Institution of Radio Engineers, this organisation is intended to provide a means of distributing information of a technical nature by means of lectures, the publication of "Proceedings", &c., and which is supplied by engineers in the industries, both in Australia and overseas. Further details may be obtained from the offices of the organisation, Science House, Gloucester St., Sydney.

H.B. McC. (Christchurch, NZ) asks us to describe a preselector using an EF50 or EF54 valve.

A. An "All-Band Preamplifier" was described in the April, 1949 issue of Radio and Hobbies and should suit your requirements. Copies of the circuit and coil data are available through the circuit query service. Your kind remarks regarding Radio and Hobbies success are appreciated.

D.W.L. (Manly, NSW) is troubled with an intermittent receiver. The fault is evident only when the set is first switched on. When the set warms after about half an hour's operation it disappears only to reappear again when the set has been out of use for a couple of hours. He seems to think it has something to do with dampness in the set.

A. You give no details of the receiver but we suspect that it is an autodyne superhet and that the trouble is in the oscillator coil. The stock remedy is to take the coil out of the set and bake it in a warm oven for a couple of hours. (Don't make the oven too hot or you will warp the former.) It would be a good idea then to give the coil a bath in hot wax or in varnish to prevent the moisture getting in again.

S.C. (No address) writes in appreciation of Radio and Hobbies, but suggests that we should devote some space to the construction of crystal sets and similar equipment suitable for the beginner.

A. Thanks for your comments and suggestions S.C. and we hope you will continue to find the various articles interesting. We have devoted quite a number of articles to the construction of crystal sets and small valve sets, the most recent being the Teach Yourself Radio series which commenced in the August, 1953, issue. Prior to this the Learn While You Build series covered similar subject matter. Circuits of these sets are available through the query service. Incidently we prefer all letters to carry the name and address, not necessarily for publication.

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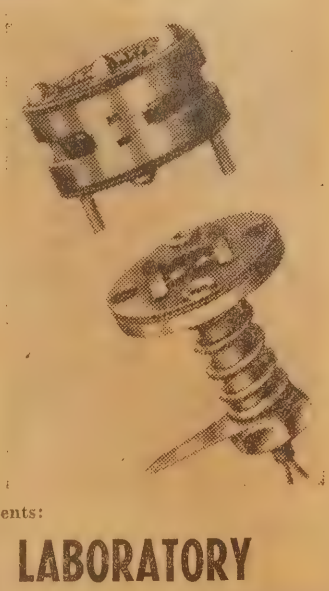

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urement of High Voltage

(Continued from Page 55)

by correcting for pressure lative humidity.
dard voltage-measuring gaps ctical use are of two types, edle gap and the sphere gap. rmer is recommended for volt- etween 10 and 50 kv; the lat- voltages higher than 50 kv. following specifications for gaps have been set by the can Institute of Electrical En- s (AIEE Standards—para- 2366):

dle Gap. Arrangement. Util- ap between points of two new s.

trode Size. Needles are e long No. 00.

trode Support. Needles are rted axially at ends of linear ctors.

port Size. Linear conductors least twice the gap length.

trode Clearance. The space d the needle gap must be clear a radius equal to twice the gap

ere Gap. Arrangement. Util- gap between the two metallic es.

trode Size. Standard sphere ters (for each sphere) are 62.5, 50, and 500 millimeters. The ture of these spheres (as meas- by a spherometer) must not more than 1 pc from that of sphere of the given diameter, he sphere diameter must not more than 0.1 pc.

trode Support. The spheres pported by shanks, the maxi- diameter of which must not 1 20 pc of the sphere diameter. rting collars or similar attach- must be as small as practic- nd must be separated from the es by a distance equal at least maximum active gap length.

trode Clearance. The space d the sphere gap should be no external bodies or circuit nents coming closer to the gap a distance equal to twice the diameter.

rt 1 lists needlegap spark- listance corresponding the com- RMS values of sinusoidal volt- . . . This may be taken as 1.

rts showing the relationship en voltage and gap length are in electrical text-books for needle taps and spheres of g diameters.

rection factor charts are also lly given to allow for the ef- f air density, in terms of baro- pressure and temperature.

re's your answer Tom

(Continued from page 69)

e that such an aerial would oken by the first sparrow that polish enough to fly into it.

al wire is usually stranded in to make it easier to handle but s about the only worthwhile ent that can be advanced in its

Tom, if you wish to try out a erial, make it up roughly with scraps of whatever wire you are. If it comes up to expecta- you can then go ahead and a permanent aerial with heavy

thickness of the aerial does e important at high frequencies it becomes a considerable pro- n of the length but that is er story.

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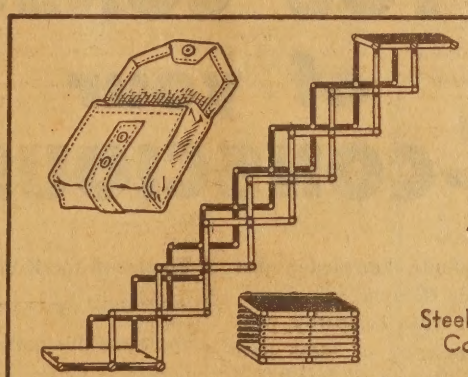

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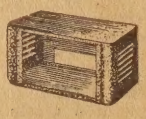

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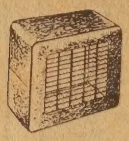

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9 x 8	3/8	16 x 12	9/9
12 x 8	4/9	20 x 9	9/3
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OM THE SERVICEMAN WHO TELLS

(Continued from Page 51)

now for something a little specific. This was a problem caused a colleague some head ing for a few minutes (I must imit that he had to tell me the r) and serves to show how mis- g an apparently simple test

story concerns a typical push- igh quality amplifier, which iend had just completed, and he was checking for residual level. Being a typical high y fiend, he works on the basis ny hum is too much and there- sists that all his equipment be quiet.

his case there was a faint hum and he set about isolating the s stages in an effort to locate urce. The circuit was a fairly htforward one, employing push- output valves, driven from a ntional triode phase changer ying load resistors in the plate athode circuits. This was pre- by a conventional amplifier and frequency compensating

AIN AMPLIFIER

rting the output from the fre- y compensating stage made no ciable difference and it was, fore, concluded that the trouble omewhere in the main ampli- So far all was plain sailing and ding to the book.

t, the triode phase changer removed from the socket and comes the curly bit) the hum diately increased in level. The impression was that the inter- n to the negative feedback cir- may have been responsible, so xperiment was tried again, with feedback loop disconnected. from the fact the initial hum was slightly higher, the effect xactly the same.

h the phase changer still re- d, the grid of each of the output was shorted to the chassis in This had no effect in the case valve driven from the cathode resistor, but completely cured um when applied to the one n from the plate load resistor.

this stage the question was not uch, "Why does it hum?" but r, "Why does the hum increase the phase changer is removed?"

TED IT?

ppose you take a few minutes efore reading any further and f you can spot the cause.)

e fact that the hum ceased when pper output valve was render- operative finally provided the to the seeming paradox, the ning being as follows: The ini- um was due to a certain amount ple in the main HT supply, this applied to the phase changer appearing across the plate and de loads as out of phase sig- exactly as if it had been applied e grid.

th the phase changer in its socket oltage across each of the two resistors would probably be t 50 volts, with the ripple con- a definite proportion of this de- ing on the characteristics of the filter system. However, when the phase changer was removed, quite a different set of conditions prevailed. With no current being drawn through the circuit, the cathode end of the cathode load resistor would drop from 50 volts to zero, while the plate end of the plate load resistor would rise from 50 volts to the full HT of about 250 volts.

RIPPLE INCREASE

As the DC voltage increased at this point, so would the ripple voltage in the same proportion, meaning that it would be about five times greater. Since this point was coupled directly to the grid of the following output valve, it is easy to see why the hum increased. Since no voltage was developed across the cathode resistor, no ripple was applied to the other grid.

Having established where the hum was originating, it was easy to add a simple decoupling circuit, wihch improved the filtering of the phase changer supply, and which completely eliminated the last trace of hum.

Industrial electronics

(Continued from Page 41)

identical with the thyratron, except in the respect of external control.

The permatron has a hot-filament cathode in its base end, an anode, usually of the circular plate type, in its opposite end. Between the anode and cathode extends a cylindrical "collector" electrode which completely surrounds the discharge path and may be connected either directly to the cathode or through a high resistance to the anode.

When the magnetic field is applied across the tube (i.e. perpendicular to the discharge path), electrons leaving the cathode are deflected toward the collector and their velocity reduced to such an extent that ionisation is prevented.

Thus, the application of a magnetic field of sufficient intensity will stop conduction of current through the rectifier. Polarity of the magnetic field is of no consequence.

When the magnetic field is removed by interrupting the magnet supply current, conduction is resumed and continues until the anode voltage is removed or reversed in polarity.

LOW TRIGGER POWER

In permatron tests, as great as 200 kilowatts of power through the tube have been triggered by 1 watt flowing in the control-magnet winding. Various low-level sources of magnetising current have been utilised in this high power-sensitivity control.

Outside of the realm of controlled rectifiers as such, the permatron has found special application in land-telegraph relay circuits, automatic battery chargers, and automatic faders for neon signs.

(By courtesy of the Aerovox Corporation).

ABOUT FLASH BULBS

(Continued from Page 93)

There are several approaches to this problem, such as the deliberate use of low efficiency reflectors, fitting diffusers in front of the lamp, lower sensitivity films, and even mounting the lamp farther from the subject than the camera.

In any case, it is most important to avoid over-exposure, particularly when the light source is directly in front of the subject, as when mounted on the camera. This type of lighting is very "flat", since there are very few shadows to show the contours and modelling of the face, and any tendency to over-expose will destroy what delicate shadows remain. The result is typical of many flash pictures and presents the face as a flat, expressionless, white-washed mask.

OTHER FACTORS

Although the guide numbers are approximately correct, they cannot take into account such variables as reflector efficiency, individual methods of processing, &c., and it may be necessary to modify them slightly to suit individual reuqirements. However, they should be close enough to ensure reasonable results even at the first attempt.

The above is necessarily a brief treatment, but it should serve to introduce the subject and overcome the beginners' major problems. At a later date we may have something to say about the practical side of making a flashgun but, in the meantime, the more enthusiastic may care to try their own hand at the job. In any case, if you want to take some night or indoor shots, a flash bulb will probably solve your problem.

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THE NEW FIRESIDE FIVE

(Continued from Page 77)

signal circuits. If you are dependent upon the broadcast stations for alignment purposes, go about it this way.

First of all, assume that the IF transformer slugs have been set at the factory and that they have not been appreciably altered. Connect an aerial to the set and attempt to tune in a station toward the high frequency end of the dial. Adjust the aerial circuit trimmer for best results and identify the station. Adjust the oscillator trimmer until the station is being tuned in at its correct spot on the dial, following each adjustment with a readjustment of the aerial trimmer.

Tune in a station toward the low frequency end of the dial and adjust the slug in the aerial coil for best results. Identify the station and adjust the slug in the oscillator coil until the station is being tuned in at its correct spot. Readjust the aerial coil slug for best results. In Sydney, station 2FC is a handy marker for the low frequency end adjustment and 2SM for the high frequency end.

Now swing down toward the high frequency end and repeat the adjustments to the aerial and oscillator trimmers. Select any station, preferably a weak one, and ad slugs in both IF transform best results. Go over thes

As a final check, repeat th ment procedure for the aer oscillator circuits. Once t tions are being tuned in correct spots, it is easier to the aerial trimmer and aer slug on an adjacent weaker at the respective ends of t

The main point to reme that coil slugs are adjusted the low frequency end of t and trimmers toward the hi quency end.

When the alignment is co it is a good plan to seal th and trimmers with a spot coil dope or nail polish.

Anti-aircraft gun

HIGH-SPEED enemy aer and guided missiles will tough time getting through flak to attack navy ships in t future.

Reason: A new anti-aircr has been developed that spli fragments into the sky muc than the guns effectively used World War II.

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Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for February issue of Radio and Hobbies is Wednesday, January 6.

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FOR SALE or Exchange: Bubble Sextant, value £10. Also Watchmaker's Lathe. **McKey, Locke St., Warwick, Q.**

FOR SALE: Production unit, complete, portable 7 Channels' meter monitor speaker, used for radio progs, excel. condition. Sell cheap. What offers? **Les Nixon, LA4512 (Bus).**

FOR SALE: Variety of valves, gangs, coils, resistors and condensers for sale **Phone MU2867.**

SELL: Rcvr. No. 14, 110 Kc.-16 Meg, Comp. & working, good condtn. £8. **B. Mason, 2 Mustang Crt., Ashburton, Vic.**

SELL: Goodman's Axiom 80. £24 or offer. Also enclosure. **LW6262 (Sydney).**

SELL: 101 8 valve Transceiver with power pack, battery, speaker and mike, 6-volt operation, faultless, £20. **B. Mason, 2 Mustang Crt., Ashburton, Vic. JA2281 during working hours.**

SELL: 16 m.m. sound films, or exch. for 6v. car radio, complete. **Schnitzerling, 72 Canning St., Warwick, Q.**

EXCHANGE, Sell: 101 Transceiver, high voltage H/D 'Xformer, pair 866's, 108 Transceiver, Magnavox Dynamic, Portable G'phone, 'Xformer, Chokes, 81, Back Numbers R. & H., Radio World, Hobbies Illust. **Schnizerling, 72 Canning St., Warwick, Q.**

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